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ABSTRACT

A series of research reports on three aspects of womens sports: the psychosocial, the physiological, and teaching and coaching are presented. Section 1 (psychosocial) mentions such aspects as societal attitudes toward women in sports, sex differences and research, and women and competition. Section 2 (physiological) considers such aspects as work capacity, effects on growth, selection of sports, pain and athletics, and the effects of the menstrual cycle on physical activity. The section on the aspects of teaching and coaching discusses such topics as teaching methods, research in learning sports, and research relating practice methods to retention. (JB)

DGWS RESEARCH REPORTS: WOMEN IN SPORTS

The Division for Girls and Women's Sports
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DGWS RESEARCH REPORTS: WOMEN IN SPORTS

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PREFACE

DGWS Research Reports: Women in Sports brings together results of research from physical education and related fields for use by those working with girls and women learning and performing motor skills or involved in competitive sports. The writing is directed toward all individuals involved with physical activity programs for girls and women. The articles have been written so that persons without a background in research and statistics can read them easily with understanding.

The Division for Girls and Women's Sports (DGWS) has recognized the need for scientific evidence on which to base its decisions relating to girls' participation in sports and has charged the Research Committee with the responsibility of stimulating and encouraging needed research. Very little research has been conducted on girls and women in sports; the limited amount of data collected frequently does not reach most of those who are working in female physical activity programs. When the results are published, many of those in a position to use them fail to apply the newly acquired knowledge because they do not understand the implications or are unfamiliar with research terminology or do not subscribe to or read research journals. It is the hope of the DGWS Research Committee that this book will provide the reader who is interested in physical activity programs for girls and women a summary of what is known to date. Emphasis has been placed on the implications this research has for the teacher and coach in these programs.

This volume is the first of a planned series of *DGWS Reports: Women in Sports.* The DGWS Research Committee hopes to prepare a second volume in approximately two years. The committee invites readers to share their needs and interests with it so that the authors of the future volume may direct their writings accordingly.

D.V.H.

SECTION 1

PSYCHOSOCIAL ASPECTS

CHAPTER I

THE SPORTSWOMAN IN OUR SOCIETY

Dorothy V. Harris
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University Park

Why is it that sports participation generally is not considered a very worthwhile or exciting experience for girls? Can we logically explain why sports make up such a small part of the lifetime activities of most women? What is the effect of sports participation on the psychological and social development of females? Does competition have a positive or negative effect on the female? In short, what role does participation in physical activities play in the development of the behavior patterns of girls and women?

While a review of the literature produced no evidence to support the notion that active participation in competitive sports may harm the healthy female, there appears to be an unwritten decree that only certain sports have a desirable effect on the feminine image. Stereotypes, prejudices, and misconceptions have served to curtail the participation of females in vigorous, competitive physical activities for too many years.

One of the main criticisms is that sports participation tends to masculinize the behavior of girls; however, there is no evidence of this. The traits necessary for high-level participation often correspond to the traits that are admirable in the male: aggressiveness, tough-mindedness, dominance, self confidence, and the willingness to take risks. Yet these same qualities are often necessary for the female to be successful in competitive life situations. Nevertheless, the young woman who participates in physical activities risks her feminine image. The stereotype frequently associated with females who enjoy vigorous activity poses such a threat that participants bend over backwards to counteract it. Examples can be seen in numerous situations: the blond, bouffant, sprayed hairdos of female track teams, the ruffles on the tennis outfits, the mod apparel worn by many women golfers; the ski togs that flatter the feminine figure, the fancy swim caps and suits, etc. All of these artifacts of femininity assist in reducing the threat of sports participation to the revered feminine image.

In spite of such efforts, the "girl jock" or the "Amazon" stereotype persists, particularly when a female chooses to participate in vigorous physical activity. In this case, she is "laying on the line" everything she represents as a female much the same as the first gal to smoke in public, or the first to appear in public wearing pants, or the first to join a profession

that had been the sole domain of the male. The female who has the courage of her convictions and no doubts about her femininity is still taking a risk when she wins a tennis match from her male opponent or dares to out-perform any male whether it be in athletics, business, or a predominantly male profession. Athletics, especially competitive sports, are still primarily the prerogative of the male in our society. In general, females who take the risk and participate in such sports are either secure in their role as a female so that participation does not strike them as a threat, or they do not care, and thus have "nothing to lose." It is those in the latter category who have produced the stereotype of the "girl jock." These females can be observed in almost any competitive situation.

For most females, the avoidance of all participation in physical activities becomes the easiest route to follow. Once little girls become aware of the "socially acceptable" feminine image, the majority choose to conform. hiding behind the claim that it isn't "ladylike" to play. However, many are actually afraid of the risk, of discovering that they cannot meet the threats involved.

Whether or not a particular sport is considered feminine depends mostly on the point of view of the beholder. Since the feminine image, or what is considered feminine, is determined by the male population, educating them with regard to the values and rewards of participation for both sexes would appear to be a logical next step. It is inconceivable that anyone would want to make the joy of participation in physical activity accessible only to males, yet for the most part that has been the accepted pattern.

Among the biggest problems faced by the girl who chooses to become involved in physical activity is that of not being understood. Most people still do not think athletics and girls go together. Lendon H. Smith, the pediatrician who wrote the best seller, *Your Child and Mine,* expressed his concern in this manner in his *McCall's* magazine column: "I worry about a girl becoming a great athlete–especially a runner. She might run so fast she'd never get caught by a boy." In the same way a suburban mother watches her 16 year old daughter easily win the 400 meters race and worries about her femininity. She is afraid that her daughter will like the idea of winning and never attract a boy because of her interest in track.

Sports Illustrated reported in an article on cross-country skiing that the interest in this type of skiing had grown very slowly among women partly because most Americans have a warped concept of the femininity of the sport. Martha Rockwell, one of the young women training for the U.S. cross-country team said, "No boy likes a girl with biceps. The only problem with any of this [training for cross-country skiing] is that you just have to wait for a boy who loves to run before you get a very active social life. Most of them don't understand what we're doing."

Willye White, a U.S. long-jumper, said that "If a girl is feminine, anything she does is feminine." The coach of the Tennessee Tigerbelles, Ed Temple, feels that his track stars are young ladies first and athletes second.

He is a firm advocate of the philosophy that "girls should be girls" and they should be willing to concede long-term sports participation to the male. He suggests that his girls hang up their track shoes after college.

Sportswriters have done nothing to change this attitude of disrespect for the female athlete; if anything, they have perpetuated it. After watching the U.S. Women's Olympic Track Team work out in Mexico City, a prominent Dutch sportswriter said, "Girls are for laughs, no? Not for sports." John Pennel, the good-looking pole-vaulter, said, "If a woman is really grunting and groaning and sweating, how can she be feminine?" Traditionally, men have been unimpressed by women's athletic ability, and have had little appreciation for the skill and beauty of movement women exhibit as they compete in sports. Even though society encourages exercise, the dedicated girl athlete faces many obstacles. Lack of understanding on the part of men is paramount; they do not understand why any girl would want to become an athlete and sacrifice time from the activities they feel girls should be involved in.

Some sportswomen quietly withdraw from the mainstream of social life. A college psychology teacher who is also a physical education instructor recently suggested that many good female athletes are almost pre-adolescent because of their narrow interests and their uncomfortable feeling around boys who are not active in sports. She suggested further that they frequently are over-devoted to their fathers and are domestic in quaint, old-fashioned ways. Underneath, she contends, they are insecure "little girls." Supporting data for these conclusions were not given, however. This type of comment is a rather sweeping generalization and there are many examples that do not fit.

Now that we are beginning to study the female athlete and the effects of participation so that we will have a greater understanding of these experiences, what about all of the girls who do not participate or who are eliminated from the teams? If we find that there are many values to be derived from participation, shouldn't we give all of our students the benefit of these experiences? Ogilvie shared some concerns about competition in a paper presented at the University of California at Los Angeles in March 1969. He found in working with young competitors that those who have the greatest need for these experiences are the ones who are being excluded. These youngsters are the least inclined to be emotionally stable, are introverted and sensitive, lack tough-mindedness, and tend to over-respond to failure. He raised a rather profound question when he asked, "Are most competitive programs really constructed to enhance the positiveness of people who are already well put together emotionally?" It appears that the youngsters who have the most to gain from the experiences of competition have the least possibility of being a part of competitive programs. We need to reconsider our value system if we are promoting a situation where only the "rich get richer" while we fail to serve the needs of the majority.

At present, without question, athletic opportunities for female participation have increased; more girls are participating and are doing so more frequently. A revolution in attitudes concerning athletic competition for girls has begun in spite of all the problems involved. It will be some time before society accepts the girl athlete as readily as her brother, but genuine concern on the part of each and every individual interested in physical activity will speed up this acceptance. We have the opportunity to test the values derived from participation when we provide competitive experiences for all skill levels. Until then, we cannot evaluate the outcomes of these experiences without bias.

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CHAPTER II

WOMEN IN SPORT: THE IMPACT OF SOCIETY

Madge Phillips
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I will not attempt to define the terms "women," "sport," "sociology," "culture," or "research." A course could be devoted to studying any one of these areas of specialization. There is a wealth of material in each category and none but the foolish would endeavor to interpret this information let alone make applications of the findings to such a complex subject as women's sports. Unfortunately, most researchers do not suggest practical applications of their work. Much of the material which I have read could be classified as hunch or speculation, and it is always essential to distinguish these luxuries from verified propositions. Gross, (15), a sociologist, must have had us in mind when he said: "The sociologist cannot make the educational practitioner's decisions for him, nor can the sociologist's research findings based on one population be applied to any educational population indiscriminately. The practitioner's task is to assess the various forces that have a bearing on the achievement of his objectives, assign them relative weights, and make a decision based on these calculations."

Hopefully, the material that follows will add a few new sociological insights and concepts to our kit of intellectual tools and help us in our deliberations pertaining to women in sport. I am willing to take the risk of assigning relative weight to the materials which I have read and to go out on a limb by suggesting some possible meanings which the material might have for those of us who are interested in making sport an exciting and worthwhile experience for girls and women. I am more convinced than ever that we need to urge women physical educators to do pure and applied research which will provide us with some answers to the many perplexing problems related to sports for women. The statement, "If you aren't a part of the solution, you are a part of the problem," is certainly appropriate here.

JUVENILE DELINQUENCY

Many individuals have the naive idea that an increase in sports, games, and athletics will reduce juvenile delinquency. According to those who have worked in this area, this is just not true. Green (14) goes so far as to

say that the continued linking of sports and games with moral integrity may be dreadfully old-fashioned, if not reactionary. An intrinsic connection between activity and character is either stated or implied when it is probable that there is no such relationship. Ben Solomon (36), a noted recreation leader, indicated that the muscle skill of a youngster doesn't necessarily do anything to his character. Note that he used the word "necessarily." According to Solomon, the value of sports, games, and athletics lies largely in the quality of the leader, coach, trainer, teacher, or other adult in charge. Sports are excellent tools for the formation and training of character when and if the leader uses these tools for that purpose. In perhaps the most controlled and extensive investigation of juvenile delinquency ever made, Glueck and Glueck (12) reported that delinquents on the average were found to be more athletic than nondelinquents, and to be physically stronger and more skilled at games. Those who do not have a vested interest in sports could deduce from this information that sports contribute to juvenile delinquency. The key word appears to be leadership.

Gordon Allport (1) reviewed parts of the famous Cambridge-Somerville Youth Study in which pre-delinquent children were studied to discover whether social service could check later delinquency. Unfortunately, those who had the services of social workers were as likely to commit delinquent acts as those without such services. But an interesting observation was made—certain types of caseworkers seemed to have greater success than others. Specifically, the warm, friendly, or informal workers who to some critics seemed actually "unprofessional" in their approach apparently had more success than the highly trained, diagnostic-minded, theoretically oriented workers. Allport suggested that this finding is potentially very significant and if substantiated should cause us to examine sharply some of our current presuppositions regarding the selection and training of personnel—indeed, our whole philosophy of the "professional approach." This information hints at an interesting dilemma. The basic motives for social service appear to be charity, compassion, and tolerance, all of which are central ingredients in friendship. At the same time, these qualities may lead to sentimentality and unwise functioning. Only strict objectivity and a professional view will apparently be effective, and yet professionalism may "freeze the heart, lead to parataxis in relationships and betray us into harmful excesses of specialism."

Is it possible that the "professional" attitude of those working with girls who are interested in sports may not be as effective as the warm and friendly approach of the informal leader, teacher, or coach? I do not mean to imply that the professional physical educator is not warm and friendly but that regardless of title, professional affiliation, or theoretical orientation, those having contact with girls in sport situations might very well stress a friendly approach with their players and teams.

CLASS STRUCTURE AND SOCIAL MOBILITY

According to Maheu (27), sport has reached its heights in the classes which are often the least privileged. It represents a form of social advancement and is often considered a sign throughout the world of advancement towards a status of equality and freedom. It is because the sports movement has been one of social, and sometimes political, advancement that it is a mass movement. Sorokin (37), an eminent sociologist, reported that physical superiority has favored the social promotion of individuals and has facilitated their social climbing, while physical inferiority has facilitated the "social sinking" of individuals and their location in the lower social strata. The thesis of White's article (44), "Social Class Differences in the Uses of Leisure," is that the use of leisure is a function of class position and that the differentiation increases with age. He also indicated that the tendency to choose leisure activities on the ground of membership in a particular social class begins in adolescence and becomes more pronounced in maturity. Stone (39) reported that an interest in golf increased with wealth but that this was not the case with baseball or basketball. Max Lerner (25) reports that the elite sports of yesterday are becoming the mass sports of today. From *Elmtown's Youth* by Hollingshead (18), we discover that bowling is a popular indoor sport in the higher class, roller skating is popular in the lower classes, and that baseball, football, field hockey and basketball are common pre-adolescent activities without a significant association with class. Williams and Scott (47) studied Negro infants of contrasting socioeconomic backgrounds and reported significantly more acceleration in motor activities by the lower-class group.

Whyte (46), in *Street Corner Society*, studied life in an Italian slum area and spoke convincingly of how social ranking within the gang or group may affect athletic performance. Interestingly, this lower-class group participated in bowling to a great extent. Those who have read this book will remember "Doc" and his unusual ability to understand the factors which motivated members of his team to perform successfully.

Another well known figure in sociology is Joe Plano from the book *Society and Education* (17). Joe was the son of an immigrant factory worker, an outstanding high school athlete who obtained an athletic scholarship and became a successful high school coach, leading citizen of his community, affluent insurance salesman, leading laymen in his church, and participant in Chamber of Commerce activities. His own son played football at Notre Dame. Joe is the epitome of social mobility because of sport.

A sociological classic, *The Gang* (40), described how political bosses attempt to gain control of gangs by encouraging them to become a club. If the politician can get his name attached to a successful athletic club, he is then able to get support from the whole athletic fraternity. It is surprising how many politicians have been official patrons of sports.

Have you wondered why so many examples from sport sociology pertain to men and not women? Is there a feminine counterpart to Frank Merriwell, Jack Armstrong, Joe Palooka, Doc, Joe Plano? Nancy Drew did play tennis but she is a heroine for young girls because of her ability to solve mysteries and not because of her tennis ability. Perhaps one of the creative and talented artists among us will start a comic strip with a sportswoman as the central figure. I question if making Lucy the best baseball player on her team would do much to promote an appreciation for the importance of sport to women in our society, but it might help. We all know that there are women who are where they are because of their abilities and experiences in sport. Social mobility is not the main reason to encourage sports for women but is there anything more romantic or heartwarming than to think of a girl who learned to play tennis in the streets of Harlem having an opportunity to play before presidents and queens?

We have heard of the baseball player who said if he weren't stealing bases he would have been stealing bananas. Many girls in sports could tell similar stories. Sport may not prevent juvenile delinquency but I have a hunch that it has made a contribution to the solution of the problem. Not all athletes have climbed the social ladder because of athletic ability, but many social doors have been open to them because of sport. Not all girls who play and enjoy softball are in the lower social class, and not all of them who play tennis are members of the upper social class. I have always viewed sports as an equalizer and believe that we can learn to appreciate people who are different by learning to play the games they play and by playing with them. Perhaps the girls from suburbia would benefit as much from playing kick-the-can in the ghetto streets as the girls in the ghetto would benefit from an afternoon of tennis at the country club. It has been said by many that a nation at play reveals the stuff of its social fabric and value system. If sports are a symbolic representation of the values of a society, then sports should change as values change.

ACTIVITY PREFERENCE-ATTITUDES TOWARD ATHLETIC COMPETITION

There appears to be general agreement that individual sports are more socially acceptable for women than team sports. Sebastian deGrazia (13) reported a study done in 1956 in which 34 percent of college educated women over 18 participated in one or more sports. The preference was swimming, golf, tennis, and bowling. Ulrich (43), in her very exciting book *The Social Matrix of Physical Education*, states: "Stratification for women is not the same as for men. For women, the individual and dual activities tend to acquire status. The team sports still have masculine overtones in terms of cultural identification, and thus lose status with regard to women's activities. The good tennis player, golfer, or badminton player is accorded a greater status than the good hockey player, softball catcher, or

basketball guard." Recently Harres studied attitudes of university men and women students toward women's athletic competition and concluded that the population was favorable in attitude but that there was considerable variance in opinion concerning the desirability of athletic competition for girls and women. There was no difference between the attitudes of men and women. Harres also reported that the individual sports, swimming and tennis, were considered to be the most highly desirable. Volleyball was ranked third, followed by track and field, softball, and basketball, in that order. In 1955, Leyhe found that most respondents were favorable toward competition in individual sports, but far less favorable toward competition in team sports. Her subjects were members of the American Association for Health, Physical Education, and Recreation and, as might be expected, women physical educators are very much divided over the question of intensive athletic competition for girls and women. McGee's (28) work in 1956 indicated that parents and coaches were more favorable to competition for girls than were administrators and other school personnel.

WHAT IS FEMININE?

According to Berman (3), the "pill" for women and long hair for men are indications of changing sex patterns far more pervasive than may appear on the surface. Men are being released from fear of displaying feminine characteristics such as tenderness, sensitivity, and sorrow. Increasing similarities in appearance and temperament cause an uneasiness on the part of many as to what the consequences will be. The task is one of using existing constructs in dealing with new material. Klaus (23), in an article on "The Athletic Status of Women," said that apart from medical objections, attempts to influence the menstrual cycle for the purpose of increasing performance fall under the heading of drugging and are therefore objectionable on moral grounds. This interference should also be renounced on purely ethical grounds since it involves the suppression of one of the most important functions of the female body.

Among the most interesting papers I have heard or read on the subject of femininity was one presented by Eleanor Maccoby, a Stanford psychologist, at a Symposium on the Potential of Women at the University of California, San Francisco, Medical Center (26). Her comments on intellectual productivity have, in my opinion, particular meaning for sports women interested in the "feminine problem." She said:

> I'm sure it will already have struck you that the characteristics associated with a rising IQ are not very feminine characteristics. One of the people working on the Fels study was asked about what kind of developmental history was necessary to make a girl into an intellectual person. He replied, "The simplest way to put it is that she must be a tomboy at some point in her childhood."

> For a higher level intellectual productivity, it is independence of mind that is required—the ability to turn one's back on others at least for a time, while working alone on a problem—and it is this which girls, from an early age, appear to find so difficult to do . . . But of course, not all girls find it difficult. Qualities that could make her into an analytic thinker are "full of curiosity," "likes to explore things," "is dominate and independent," "probably likes to play with boys and wear blue jeans," and "isn't especially interested in dolls." Assuming that her parents have been tolerant of her temperament, what happens when she enters school? One of the first blows is that the boys won't play with her any more . . . From the standpoint of those who want women to become intellectuals, this is something of a horror story. It would appear that even when a woman is suitably endowed intellectually and develops the right temperament and habits of thought to make use of her endowment, she must be fleet of foot indeed to scale the hurdles society has erected for her and to remain a whole and happy person while continuing to follow her intellectual bent . . .
>
> Do we want to encourage intellectuality in women if it must be done at the expense of femininity? . . . I wonder whether our current social definition of the feminine woman and girl could not undergo some revisions without any damage to the essential functions of women. Does a woman really need to be passive and dependent in order to be sexually attractive to men, or in order to be a good mother? Could we not accept and encourage the active, dominant, independent qualities of the intellectual girl without labeling her as masculine, and encourage in her whatever aspects of femininity are compatible with an analytic quality of mind?

Teaching engineering is a profession which is opening for women. Jessie Bernard (4), author of *Academic Women*, in a paper on "The Present Situation in the Academic World of Women Trained in Engineering," has some interesting advice for the women who wish to enter this field: "If or when your generation breaks the sex barrier in engineering schools and technological institutes, as it was broken in medical schools a long time ago, remember that it will be a new situation to the men you have to relate to, both fellow faculty members and students. Help them. It will be harder for them than for you. You are better prepared than are the men for the change. If they haze you, take it in your stride good-naturedly if you can; above all, be yourself. If you are a very feminine person who loves jewelry, finery and the like, do not smother it. But if you are the tailored or the casual type do not think that you have to indulge in ruffles and bows in order to prove that you are a woman."

Women in other areas have not been as defensive about femininity as women in our field. At the Fourth National Institute on Girls Sports, Phebe Scott (35), presented a paper, "Food for Thought for the Future," in which a refreshing approach, and definitely not defensive, was made: "One of the major criticisms is that athletics tend to masculinize the

behavior of the girls. There may be such a trend unless we as teacher-coaches take steps to prevent it. On the other hand, we need not dress our women in satin uniforms which resemble bikinis--for there is absolutely no correlation between fancy outfits and the number of goals scored. Of central importance is good taste and attendance to the task at hand. Uniforms should be well tailored, permit freedom of movement, and be easily laundered. In short, costumes should be utilitarian in design rather than suitable for go-go girls."

Laura Huelster (19), in an excellent paper on "The Role of Sports in the Culture of Girls," discusses an article from *Redbook*, "How Women See Themselves." In this article it was concluded there is little difference among women with different racial, ethnic, and economic backgrounds as to how they view themselves and as they ideally would like to be. The slight difference noted was in the direction of wanting to be more aggressive. The women tested thought men would like them to be more submissive than they were, but when men were polled in this regard it was found that they actually did not want women to be as submissive as women thought. Dr. Huelster suggested that there seems little doubt that the cultural environment is increasingly favorable to women's self-assertion.

We all realize that culture determines what is feminine and what is masculine. We also realize that we are a part of culture and help in making these determinations. Women in our society have not always voted, practiced law and medicine, owned property, or participated in Senate affairs. Not all women do these things now but those who do are not necessarily more masculine because of their accomplishments. India and Israel have established a precedent which may make it easier for a woman in our country to be Vice-President or President. Women are being accepted as human beings at all levels in nearly all professions. Why then should we not encourage women to be active participants in sports? Women physical educators have made significant gains in stressing femininity in sports. We need to continue this positive approach. To paraphrase Dr. Maccoby, we could accept and encourage the qualities of the athletic girl without labeling her as masculine, and encourage in her whatever aspects of femininity are compatible with excellence in sport.

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CHAPTER III

ATHLETICS AND COMPETITION FOR GIRLS AND WOMEN

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It appears that competitive sports for women are here to stay and that these programs are becoming more acceptable every day (3, 7). Thus, it would seem appropriate to discuss some of the knowledge we have about the woman athlete. We worry about developing the same problems that plague the men's programs and, perhaps because of this, scorn the help of those working in such programs. One cannot help but wonder how men's athletics *ever* became classified as a communicable disease! Perhaps our own caution, prejudice, and timidity are to blame for the stereotypic view of the woman athlete and for failure to meet the needs of the highly skilled woman. Whether her skills and femininity are cultivated and enhanced would seem to depend on how well those of us who work with her are doing our job. Perhaps our most important task is to develop and substantiate the concept that a woman can be an athlete and remain a woman.

We know that the female athlete is first and foremost a girl or a woman. From this base grows her concept of herself as a person and as a performer, and from it she develops her direction in life. We know that she certainly differs from her male counterpart. She survives gestation, birth, and infancy more efficiently, and she develops more rapidly than he does. She is ready for school at an earlier age, and she seems to adapt more readily and do better scholastically once there. She reaches biological maturity sooner, but her responsiveness to and interest in sex appear later and seem to involve a different emotional commitment. We know she is allowed to manifest a far greater range of emotional expression than is the male. She seems to have a deeper psychological sensitivity. She may value games, practices, victories, and losses differently—perhaps because of differences in psychological make-up or because of social conditioning. In general, we know she tends to live longer and to be healthier than the male. We know she differs from the male in strength and endurance; yet she can enjoy sports which are modified or derived from his. Women's coaches should be cognizant of all these differences which distinguish women from men, and our programs should use them to advantage.

We need to be concerned with the physiological effects of intense training and competition on women. Astrand's (1) work suggests that

when the same sensible precautions are taken with women as with men, women suffer no ill effects. Erdelyi (5) indicates that pregnancy and childbirth are executed with more ease in the woman well trained in athletics. The claim of "physiological damage" is often used simply to justify the failure to provide good training procedures and good competitive experiences and is both illogical and demeaning to our ability to apply research results.

Understanding the "physiological woman" would seem to require research on the effects of athletics on women who began competing and training at a young age. What happens to them physiologically after activity is stopped, and how healthy are they during their twenties, thirties, forties, etc.? Physiological concerns also demand that we go to the men for assistance. They seem to be years ahead of many of us in training methods, coaching approaches, and motivational procedures. A combination of research results and information from our male co-workers might lift our work from the realm of "guessing" to scientifically substantiated approaches.

If our major concern *is* the girl or woman—secondary considerations being skills, contests, and won-loss records—it might be helpful to know a few of the things research tells us about the psychology and the sociology of woman. However, extreme caution is suggested in interpreting these kinds of research results. We read that participants in team sports are group-dependent, but we fail to realize that methods of measuring personality are embryonic in terms of sophistication and accuracy. We also fail to realize that samples are often small and regional; yet we generalize to the whole population. Our understanding and awareness of these research results are important but more in terms of tendencies than absolutes.

Limited research on the college level does indicate that the woman who participates in team sports is more group-dependent, more anxious, and lower in leadership interests than her peers in individual sports or her nonparticipating peers (9). Team-sports women have stated that they are more unsure of the contributions athletics make to their femininity and social acceptability. Many state they participate in spite of negative feedback. Yet these women are more like their nonathletic peers than they are dissimilar.

As to the relation of the Women's Liberation Movement to femininity, I suspect that most of us react with ambivalence. My own view is the Movement's ideal woman is a kind of hard, clever, selfish soul. Sensitivity and compassion seem to have become unfashionable.

But what is femininity? In the last analysis, what does it have to do with being highly skilled and winning in athletics? Somehow, society has taught us that there is something "abnormal" or "different" about the

woman who pursues athletics. We are the guilty party; we have accepted society's diagnosis. Skill and victory should not and probably do not dissolve, negate, or detract from femininity. As so many of the highly skilled women athletes in this writer's research have stated: "It's not the sport, or the skill, or the score; it's the participant that determines whether her participation enhances or detracts from her femininity." By providing an honest model of the woman competitor in our coaching, we can, I believe, make at least some of the proper responses to the possible insecurities of the team-sports participants.

The results of this writer's research with women competing in individual sports is, quite frankly, confusing! The evaluation of 59 aquatic artists showed no significant personality differences between them and their nonparticipating college sisters. Work with the participants in the national intercollegiate golf and tennis tournaments indicates that there are different differences between each sport group at each tournament! One year there are only three differences, the second year there are ten (10). Despite these inconsistencies there appear to be more similarities than differences between women athletes and the general college population. Those differences which do exist are generally positive—for example, more intelligence, more self-sufficiency, more openness to change, etc. These participants are extremely positive in their view of the effect of participation on their feminine image. They feel it enhances that image, makes them more "datable," makes them more interesting to be with. Their statements, in general, seem to indicate much more security about themselves as women than did statements from team-sports participants.

What do these findings mean to the coach of girls and women competing in individual sports? Primarily, they mean a more cautious and tentative application than suggested above. Participants in only two individual sports were studied and they represent a very small percentage of the girls and women in the United States involved in these activities.

The findings also demand our acceptance of the woman athlete primarily as a young woman and secondarily as one who is interested in activity and competition; she differs very little from Jane College. She is not some peculiar, though skilled, bit of muscle and skeletal tissue run by an equally skilled nervous system and psyche. Perhaps our own surprise and delight with a high skill level causes us to react differently to this individual. Perhaps we project some of our own frustrated ambitions and prima-donna behavior to this young woman. As coaches, we need merely to remember that, in all probability, the individual sports competitor is just another young woman in school or on the campus. She has skill. She has a desire to test it. She has sports experience. These are the only differentiating factors.

We have some very limited information which indicates that coaches do not know their players as well as we like to believe (9). Those involved with individual and subjectively judged sports seem more knowledgeable about the personality of their participants than the team-sports coaches.

The coach of individual sports tends to overestimate intelligence, and the coach of subjectively judged sports views her participants as more out-going and more self-sufficient than they actually may be. The coach involved with team sports may misjudge her players in more areas. She tends to assume her players to be far more outgoing, happy-go-lucky, venturesome, and controlled than they are.

What does this information tell us? Again, we must be careful not to overgeneralize. We may need to know our young women as total individuals, particularly those in team sports. They are far more than basketball, hockey, or softball players. To understand who they are really might help us in our role as model, and it might help to reaffirm and reassure them of their womanliness as well as their skill. It is important for the coach of young women to know some of the feelings they have about athletic competition. Why do they compete? How do they feel about winning and losing? What are their reactions to practice? A general review of some "tentative answers" follows (9, 10).

A frequently mentioned reason for competing is that it provides an opportunity to meet people and to develop friendships. Love of the sport or enjoyment of the game tends to alternate with the "people" aspect as the number one reason for participation. Mentioned fairly often is the skill level. Women who are highly skilled indicate that they enjoy the challenge of testing their skills.

Feelings about winning and losing seem to be based on the opponent's skill. The women studied in this writer's research tend to be angry when defeated by someone with poorer skills. They become disgusted with themselves when they have performed poorly. When skill levels and performance levels are equal, they tend to be challenged and to feel discouraged when defeated. "Poor sport" responses are seldom offered; nor are lengthy "excuses" heard. Winning results in good feelings, but again the feelings are somewhat dependent on the opponent's skill level. Usually the women are pleased or happy, but they are also challenged by victory. Prima-donna responses and self-aggrandizement have not appeared.

Reactions to practice time indicate that sports women realize that this time is essential to good performance. Many believe it is insufficient and they would like more time. Occasionally a remark is made that it is difficult to practice and to participate in nonathletic school activities.

These attitudes toward winning, losing, and practice time strike this writer as descriptive of a young woman who has a fairly solid sense of herself.[1] They suggest a woman who has resolved the extent to which her athletic activities will involve her life. As coaches and directors of these activities, we would seem to be most helpful when we direct our efforts at maintaining the fine sense of proportion that many women athletes already have. We are not dealing with extreme reactions. The gentle concern and sincerity of women about practice and performance need only support from us.

In conclusion, we know a great deal about the woman athlete, but we need to be careful about applying scattered research results to all women athletes and their coaches. The research, as interpreted by this writer, indicates that these women are not very different from their peers in personality. Some may be concerned about the effect of their sports participation on their feminine image. Others see this participation as enhancing their femininity and broadening their opportunities for social activities with men. Reasons for participating seem to involve the love of sport and people. Reactions to winning and losing are reasonable.

A consideration of this information suggests several undertakings. Much more information is needed concerning the mechanics of coaching and training. What happens to the intensely trained young woman? Just how big do the muscles become? Why does she retire at 16? After retiring, what are her feelings about competition? How can we become the best models of femininity and gently help some of these girls to realize they are women? The first glimmers to the answers to these questions could probably be gathered through "action research." Anecdotal records might be the method. A sharing of ideas with each other and with our male colleagues would also seem helpful.

Athletics for women have arrived. It is this writer's opinion that with their arrival comes a wonderful sense of satisfaction that we are *finally* beginning to meet the needs, individual differences, and interests of the highly skilled girl or woman. Acceptance of this kind of program for women can probably be best accomplished by providing a less defensive and apologetic model for both our girls and our men helpmates across the gymnasium or the street. Competition does not need to be destructive of femininity, budgets, administrative relationships, physiology, or the psyche. Our role as model is an exciting one. Our realization of the soundness of a bit of Aristotelian philosophy, "Nothing in excess," is demanded.

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CHAPTER IV

HOW SEX DIFFERENCES AFFECT RESEARCH IN PHYSICAL EDUCATION

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Women have, throughout recent decades, become increasingly involved in the social, economic, political, and philosophical concerns of our nation. They now represent one-third of our nation's total working force, albeit they represent only one fourteenth of those working in the scientific and technical fields. Women are not equally represented in the upper echelons of business, industry, and government, but the percentages in these areas are steadily increasing. Much of what we think and know about women is based on myth or inherited philosophy, and there is abundant speculation about whether women are psychologically or physiologically capable of assuming certain roles in our society. There is definitely a need for much more scientific information about the basic abilities of the two sexes, and specifically those of women.

At least two basic potential causes for sex differences exist: environmental-experiential, and biological. If biological sex differences do exist, we need to establish their exact nature in order to understand better the ways in which environmental influences and experience may minimize or maximize their impact. It is also important to determine whether the environment is actually creating differences between the two sexes that do not biologically exist, or whether it is obscuring the function of existing biological sex differences by exerting social pressures toward egalitarianism.

Research has provided us with much less than unanimity concerning the abilities and characteristics of women, and just as little information concerning how they may be similar to or different from men. In the past, researchers, a majority of whom were male, primarily investigated only the characteristics and abilities of male subjects. Garai (6) reports that in one segment of the psychological literature 35 to 38 percent of the research studies have utilized male subjects. Only 5 to 12 percent utilized women subjects, with the rest of the investigations using both males and females. In the physical education literature last year, 56 percent of the studies used male subjects as the source of data, while only 19 percent of the investigations utilized female subjects. Seventeen percent collected data from both males and females and, surprisingly, five percent of the studies failed to specify the sex of the subjects. Ten years ago these percentages were even

more biased toward male subjects. Sixty-five percent of all studies reported in the *Research Quarterly* utilized male subjects. Only 18 percent investigated the abilities of women, and 11 percent utilized both males and females as subjects. Several of the studies not specifying the sex of the subjects sprinkled clues about that indicated the subjects probably were male, but since the issue was unclear they were classified as "unspecified." Even when investigators did use both sexes as subjects, many of them ignored sex as a potential variable. Of 29 studies in 1968 that utilized both males and females as subjects, only 5 reported analyses that included sex as a variable.

Evaluation of the efficacy of inferring generalizations to female populations from studies using male subjects must initially entail a determination of how dissimilar the two sexes are and in what characteristics. Although there has not been a profusion of studies investigating potential dissimilarities, there have been findings that indicate the two sexes are significantly different in several areas. These areas are motor skill, learning, maturation, motivation and aspiration, perception, interests, attitudes, values, and some factors of personality. Furthermore, evidence is accumulating that reveals that even when similarities in behavioral responses of the sexes are found, these may nevertheless conceal functionally different patterns of response.

One precaution must be stated before a discussion of the dissimilarities of the sexes is initiated, and this is that we must remember that the distributions of males and females on some variables overlap. We are all aware that when one speaks of females one is usually speaking of a theoretical population of females, and so to be more definitive we use the concept of the average female. We must be continually aware that as we talk of the average male or female this third standard deviation will invariably rear his or her ugly or glorious head. We might also keep in mind the complaint of one woman, "Why is it that when a man does something foolish we say, 'Isn't he silly,' but when a woman does something foolish we say, 'Aren't women silly?'" Nevertheless, if we are to discuss inferences, we must speak of parameters, and if we speak of parameters, we must use the descriptive terms at our disposal, one of which is the mean.

Cabeza (3) asserts that there is no question but that the differences in motor skills of males and females are enormous, and he amplifies this by contradicting those who claim that males and females are functionally the same in this respect prior to puberty. The male organism is physically stronger, heavier, taller, and more active. Since he matures more slowly and for a longer period of time, he has a greater opportunity for development of physical skills. This prolonged period from puberty to adulthood in the male merely enhances his inherent advantage in sports and other physical tasks. The sports records of women only reach 60 to 90 percent of those of men. The male is superior in speed and coordination, ball throwing, reaction time, skill in tapping exercises, and the pursuit

rototary. The female, on the other hand, is superior in manual dexterity. She scores better and compares more favorably with males on tests of balance, agility, and less strenuous activities.

Evidence exists that females and males learn differently. Women are generally superior in rote memory tasks—if the material is interesting to them—and they are generally more verbal. Males enjoy problem-solving techniques, and make higher scores than females on a scale of attitudes toward problem solving. Men score higher in mechanical ability, and in reasoning. They avail themselves of environmental cues to solve problems more than women do. Those women who identify themselves with the male sex role are significantly better problem solvers than women who identify themselves with a feminine sex role.

Although females have been shown to tolerate monotony in a motor task better, males perservere longer under task difficulty, stress, or anxiety. In one psychological study, males and females worked at two tasks: one difficult and one simple. All subjects were allowed to succeed on the simple task, but were stopped before they had time to determine the solution to the difficult task. When the subjects were recalled to the laboratory on a following day, they were provided their choice of which task to repeat, the simple or the difficult. The males chose to work again on the task that they had failed to complete, whereas the females desired to repeat the task in which they had obtained a successful performance.

Male subjects' learning has been shown to be unaffected across conditions of reward, punishment, or neutrality, whereas female subjects learned more rapidly under either reward or punishment. Littig's male and female subjects learned trigrams under conditions of reward, punishment, or neutrality. Positive statements, such as, "You're doing fine. Excellent. That was very good," voiced throughout the learning period constituted the reward condition. The punishment condition required that the subject learn while the test administrator injected negative comments such as, "You had a lot of errors that time. You're a slow learner. You're very slow. My God, you students are dumb." Females learned more rapidly under these punishment conditions than did males.

In terms of motor learning, when the tasks are novel to both sexes and do not require strength or endurance in appreciable amounts, there is generally no significant difference between the sexes. Bachman (2) found no difference in the rate of learning in large muscle skills between the sexes, although he did find some sex difference in initial performances during the post pubescent stage. Alderman (1) reported that males were better than females at learning the rotor task at both ages 10 and 14 years.

We may speculate that since women are seldom called on by society to exhibit raw strength or power, there is probably a substantial amount of learning that occurs when women are placed in test conditions that require all-out levels of strength. Although many studies report that there is no significant trend effect when men undergo three or more strength trials using the tensiometer, we have consistently found a significant trend effect

when women are measured in three trials of isometric strength. Kroll (8), Guinn (7), and Mullen (11) have found unexplained increases of 8 to 15 percent in isometric strength over periods of three weeks. These increases were furthermore maintained with no additional training over a period of three months. Kroll postulated that these unexplained increases might be caused by motor learning, reflecting an adaptation of neural mechanisms associated with the expression of maximum isometric strength. His male subjects did not, as did the female subjects, produce within-day isometric strength scores that could be described as trending either upward or downward. The women improved with each subsequent trial within each day. This finding can only be explained in terms of motor learning, and implies that trial effects must be examined when women subjects are utilized, that criterion scores must be selected on the basis of statistical analysis, and that it is probably wise to provide familarity test opportunities to women who are expected to yield all-out isometric strength or endurance performances.

Motivation is a variable that must be considered by any investigator who seeks valid results from a study utilizing human subjects. Discussions of whether subjects should be extrinsically motivated, whether motivation should be standardized in some way, or whether investigators should even attempt to motivate subjects, usually end in controversy. Whatever the decision of the experimenters, our discussion must consider whether women and men respond differentially to attempts by investigators to motivate them.

Many investigators who have not obtained anticipated results from women have resorted to the rubric that the women subjects were not highly motivated. Some investigators have suggested that females will be useful as subjects only as much as they are motivated. A natural response to this comment is, "But isn't this true of all human subjects, male or female?" The answer is yes, but males are more naturally motivated toward the activities that we frequently test, and furthermore the males are more interested in self-testing. Garai (6) asserts that men have a higher achievement motivation and set harder goals for themselves. They are usually interested in the testing apparatus, appurtenances, and mechanical trappings more than women are.

Fleishman (5), Espenshade (4), and Scott (13), have all found decreases in fitness levels and motor performance of girls as they reach the age of 13 to 15. There appears to be no physiological reason why this occurs, and they have hypothesized that, since our system of values does not represent strength and endurance as "fashionable" attributes for young women, the girls lose motivation to perform physically as they approach young womanhood. One investigator has reported that females give an all-out effort in motor performance up to the 7th or 8th grade, after which—except for the highly skilled and motivated—performance decreases.

Rich (12) found that older girls fatigued more slowly than boys. His discussion concerning this finding explains how a difference in sex might influence the findings of a research investigation, thus causing the investigator to come to erroneous conclusions about physiological phenomena:

> The older girls, however, do approach the fatigue level more slowly than the younger children of either sex, and the older boys approach it somewhat faster. This difference may be the result of motivational-cultural rather than physiological factors. It is a common observation among experienced high school physical education teachers that the cultural pattern for these ages results in greater motivation toward demonstrating physical prowess in the males. The opposite situation seems to be present in the females as they mature. If this holds to even a moderate extent on the average, it could have enough influence to cause relatively greater exertion in the older boys in their first few muscular contractions on the dynamometer. Having done more work in the first part of the fatigue curve than would have been the case had their effort been less, there would not be as much energy left for succeeding contractions. The fatigue curve would therefore tend to fall more rapidly. The opposite situation would function in the case of girls, and thus tend to result in a slower fatigue rate.

It has been reported that the effort and consistency of the performance of females 16 to 30 is directly related to their concept of the importance of the task in relation to their personal needs. For instance, girls will work at flexibility exercises scrupulously if better flexibility will enhance their chances to become a cheerleader. Women appear to be more motivated by external motivators, such as praise and social recognition, whereas men are motivated by the self-satisfaction they derive from completing the task. A female's self-evaluation depends on her peer's approval, but this is not true with males. Males perceive a test of physical attribute in a research study as a personal challenge, and begin the trials with a competitive attitude that may be as much self-competition as competition with others. Women may grow more competitive throughout the study if they are motivated, but this in itself is a confounding factor in any analysis.

Vincent (15) has recently published results that refute these findings. She found that ninth and tenth graders surpassed seventh and eighth graders on several items that included running, jumping, throwing, balance activities, and agility. She suggested that since the earlier tests that found girls' performances decreasing, there have been changes in cultural expectations of females. There is currently more acceptance of sports competition for girls and greater opportunities of physical activities.

The level of aspiration of the two sexes has also been ascertained to be different. Males feel a greater need for achievement, and therefore aspire to higher goals. Marzolf's (16) interesting study reported the hypothesis,

which was substantiated, that because males' aspirations are greater, the goal discrepancy scores of boys would be higher than those of girls. He suggested that since the task to be accomplished was hitting a ball, it might have been a more ego-involving task for the males, although it did not empirically seem so to him. He further speculated that the school is more likely to reward feminine virtues of docility and submissiveness, consequently males may have more of their behavior go unrewarded. They might, therefore, be more frequently frustrated and consequently set higher aspiration levels for themselves.

Wessel's (17) finding that grip strength was related to grades in physical education was attributed to the fact that girls who have been more active are stronger, better skilled, and more interested in achieving a high level of competence. The decreased interest that adolescent girls exhibit in physical performance causes them to become problems as subjects of scientific investigation where fitness or skill parameters are to be explored. By age 15, their social status is independent of their athletic ability, whereas a boy's status is dependent upon his ability. One investigator found that almost all variables for which reliability coefficients were markedly lower for one sex than for the other involved subject matter in which there were marked sex differences in the amount of interest that the subject had. Whereas males are interested in the theoretical, abstract ideas, practical success, and scientific knowledge, females are more interested in art, religion, the welfare of others, and personal comfort. Wessel (18) found that grip strength differed between groups of subjects where one had a high and the other a low attitude toward physical education activity. Those who were strong, both in grip, back lift, pull, and push measures also had a high attitude toward physical activity.

It appears, then, that there are many variables in which men and women have been found to be statistically different. It remains for us to determine how these differences might evoke special problems in the use of women as subjects in scientific investigation.

An initial problem of data collection is the procurement of subjects. Many subjects are obtained by plucking them from physical-activity classes in college situations, yet it is apparent from all that has been said and observed that women are not likely to be randomly distributed among various activities unless their participation in a class is decided by a computer. In other words, if activities are elected, we are likely to find an entirely different cluster of previous experiences, skill abilities, attitudes, interests, and motivations in a gymnastics class than in an archery class. If the investigator is interested in applying his inferences to the entire population of college women, the type of activity from which the subjects were obtained must be considered.

A highly questionable technique that is commonly utilized by investigators is that of obtaining volunteer subjects. Factors that might influence volunteering are motivation, general idea of the study as it is

presented, nature of the subject group itself, the relationship of the experimenter to the subjects, and the measures to be used. Research has shown that women tend to be more apprehensive about the prospect of being a subject than men. Once participating, however, they tend to be less suspicious of the instructions and procedures than men. High percentages of women promise to volunteer for a study and then fail to show up at the designated time. Levitt (9) has found that when the personality inventories of these "pseudo-volunteers" were combined with those who really appeared for the active data collection, the results of the study were appreciably changed.

Wilson and Patterson (19) have reported that sex is a significant factor in volunteering behavior. More men volunteer than women, and when women do volunteer they are less inclined to give their names or have the results known. Many of them volunteer more or less unwillingly, and then fail to appear. Those investigators who are willing to risk the possibility of sampling bias resulting from the use of a volunteer technique for obtaining subjects, should also be aware of the female's habits in volunteering. The investigators should keep in mind that if the female feels that the research is for a worthy cause and is of importance, she is more likely to volunteer and complete the investigation. She is even more likely to complete it if she feels the findings will be directly beneficial to her.

Another problem that the female presents to researchers is her tendency to be more variable in her responses. Females have been reported to be more variable in weight perception acuity, memory of weight perception, self-image, time judgements, galvanic skin responses, blood pressure in response to training, physical performance measures, and an extraordinary number of other variables. In short, very few, if any references have reported males to be more variable than females. Since variability directly affects many types of statistical manipulation, any investigation that utilizes women, or both sexes, should determine whether the samples are homogeneous in variance before relationships or differences are tested. Heterogeneous variances can, for instance, inflate *t* values in small samples. If women are over three times more variable than men in a small sample, a significant difference might be obtained that does not truly exist.

A final important sex difference that is perhaps a serious research problem is that the subject's sex and the investigator's sex can interact to produce different scientific conclusions. These interaction effects are most apparent in studies of social conformity, operant conditioning, verbal conditioning, test responses and test anxiety, dependency, attention seeking, aggression, problem solving, difficulty of goal choice, decision making, and scholastic achievement.

In general, the level of performance of both sexes is higher when they are tested by the opposite sex. Being tested by a member of the opposite sex may result in increased competiveness, higher anxiety, and a greater desire to please. Subjects tend to pay more attention to instructions when

the experimenter is of the opposite sex. It has also been shown that if a woman or a man *is* effective in eliciting a high response from his or her own sex, then he or she is equally effective with the opposite sex. Higher IQ's have been elicited for subjects when experimenters were of the opposite sex. One study has shown that females learned more rapidly with a male experimenter than with a female experimenter.

Silverman (14) reported that experimenters can affect the outcome of an investigation if they have an expectancy of the outcome of the study. In each case where the experimenter had a hypothesis concerning the outcome of the results, he was biased in the direction of the hypothesis. This bias was compounded when the sex of the experimenter and the subject was not the same.

In our profession there is a very definite tendency for male researchers to incorporate males as subjects and for women to use females as subjects. In 1968, of 92 studies using males as subjects, only one was conducted by a woman. Of 32 studi s using females as subjects, only one was reported by a male researcher. Few, if any of these studies, indicated whether data collection was accomplished by male or female. There have been practically no studies that have investigated the sex of subject and sex of experimenter paradigm in spite of the reality that much of our research is concerned with parameters that are differentially oriented toward one sex or the other. Certainly there is much that needs investigation in this area.

In summary, it seems that we are working upon an unwarranted assumption if we imply that findings obtained from studies employing one sex can automatically be generalized as applicable to the other sex. In order to secure precise scientific information about women, as well as how they differ from men, we should be guided by the following considerations:

1. Sex differences are likely to affect findings in many vital areas.
2. Statistical equivalence between sexes may obscure qualitatively different behavior patterns.
3. Wherever the sex of a subject and of the experimenter is different, tests should be conducted to determine whether this is significant and will affect the results of the study.
4. Women's interests, attitudes, and motivations will directly influence their usefulness as subjects, and thus these should be carefully evaluated.

Finally, if women *do* seem to present problems as subjects in scientific investigations, I think we can all agree, as we turn the key in our laboratory or gymnasium doors at the close of day, that it is most gratifying that sex differences, with their concomitant interactions, do indeed exist.

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CHAPTER V

GIRLS COMPETE ???

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Historically, the American sportswoman is a recent phenomenon. Her image is directly related to the changing role of women in this century.

In the early 1900's the ideal woman was portrayed as the matron: buxom, plump, and motherly. Her role was that of child-bearer, housekeeper, and cook. By mid-century, however, the mature woman was learning to lead a new and different kind of life. She was still motherly but in a more shapely way. She was also becoming more self-reliant and independent. Besides raising a family and keeping house, she worked, joined clubs, and became active in community affairs. During this same period sports were becoming an integral part of the American life. Thus, it seems only natural that as the new concept of the woman's role evolved, the sportswoman should emerge.

However, despite her new independence and her increased opportunities to choose the extent of participation, the number of females engaged in athletics has remained quite small. Why is this so? Does the existence of divergent opinions about female athletic competition affect the number engaged in such participation? Or are there a multitude of personal independent reasons why a girl shys away from being an active sports participant? Possibly athletics is simply not the "in" thing for girls to do. Society expects boys to be active and involved in sports, but should girls? Certainly athletics are not a part of being feminine, says society; masculinity is the proper trait for sports. Could it be then that girls are simply reluctant to participate because of role conflict and if given time in a world of changing attitudes and values the number of female competitors will increase?

To date there is little effort being exerted to answer these questions. However, after some research and an intensive review of literature on the subject (much of which is unpublished) answers begin to cluster around a common theme: our individual values. What the individual does, how she thinks, what she has, what she secures, what she advocates, her social relationships, all are based on her values. Where do these values come from? For most it is society which determines and transmits to the individual that which is of value. The individual is influenced in such a way that some things have worth (or value) and other things have none. On the other hand, it may be the individual's unique interests, feelings, apprecia-

tions, attitudes, and desires that influence her to value certain things. Whatever the source of values and whatever the means of their acquisition (and there are many theories), an individual cannot escape them. Therefore, if physical activity and competitive sports are valued for or by girls they will participate.

It should be made quite clear, however, that values do not necessarily mean a choice between good and bad. Investigations reveal that some of the more frequent reasons given for lack of participation in competitive athletics by girls are lack of participation by friends, pressure of studies, nonparticipation in physical education, and a feeling of inadequacy in sports (3). The fact that older students become interested in a greater diversity of activities also accounts for a lack of athletic participation. (2), (3) Research at the high school level indicates that freshman participants greatly out number senior participants.

In addition, a girl's parents may have considerable influence on the extent of her extracurricular participation through high school. Nearly every girl, according to a study completed in 1958, consulted her parents before beginning an out-of-school activity and approximately two-thirds of the girls said that their parents believed that such an activity was valuable but not essential (4). Among girls 15 to 22 years old, the academic environment, the menarchial age, the chronological age, deviations from the menarchial age, the length of experience with the activity, and to some extent the degree of skill were found to be influencial factors (1).

Many studies concerned with factors influencing the participation of college women produced results similar to those of high school studies. Among college women, a lack of time, for the most part because of studying, was the most important reason for the small amount of participation (8). Further investigation revealed that lack of participating companions and attraction of outside interests to be the next most important reasons (8). Another study on the factors affecting the female sports program showed that women enrolled in physical education classes were more likely to participate in extracurricular sports activities sponsored by the Women's Athletic Association (7). Additional factors influencing participation include lack of adequate facilities, insufficient number of staff members, communication, other activities scheduled at the same time, need to pay for own equipment, lack of previous experience, lack of organization, need for skill instruction, and dislike of losing (3), (7).

In all of these studies, the individual's decision about whether or not to participate did not involve a choice between good and bad, but a choice between two good things, and whichever was the most important at the time, (money, studies, skill, etc.) determined the outcome. Thus, to engage in sports competition becomes a matter of values.

It is interesting to note that neither the "messed-up" appearance resulting from activity and showering nor the kind of clothing required was indicated as an important deterrent to participation. This is not to say

that the female does not consider these, for teachers often hear, "Why do I have to shower? I can do it when I get home," from students crowned with hairdos that took 45 minutes to style. Perhaps the reason that these factors do not restrict the female is simply that girls and women value physical activity more than they mind these occasional inconveniences. Also, none of the bio-physical concerns such as masculinity, overexertion, menstruation difficulties, fear of nonconception, or lack of energy appeared to be important in limiting female participation in sports activities.

Given our present understanding of the human body, it is not hard to understand why most of these were not mentioned, but why not the first? Especially since one often hears it said that the female athlete is mannish. What does this term mean? Is it related directly to looks? In a study concerning attitudes toward female softball players, respondents believed such players to be generally attractive (5). Why then are female athletes thought to be unfeminine? Or are they?

To see how society thinks about the female athlete and her femininity three research projects were recently conducted (5), (6), (9). Two of these studies, one by Bea Harres in 1966 and one by myself in 1969, produced some interesting results. Because both projects utilized the same attitude inventory and background questionnaire, comparison of findings was not only easy but fairly accurate.

In my study, parents and teenage girls saw little that was unfeminine about female athletes but thought, as did teenage boys, that such activity was better suited to the physical make-up of the male. About half of the teenage girls did, however, believe that girls who participate in intensive competitive programs tend to develop masculine mannerisms and attitudes. Teenage boys were the most critical of the female athlete. The majority said that intensive competition in sports brought out undesirable qualities in girls and that girl athletes develop mannish characteristics. These boys were equally divided on whether girl athletes are socially accepted by their peers, on whether the competitive drive necessary for success in athletic competition is an unfeminine trait, and on whether the girls receive any advantages from identification with an athletic team. The extent of criticism by teenage boys was not shared by their older counterparts. Results of Harres's study indicate that college men were as favorable as college women toward female athletic competition (6). Is it as Harres has said, that "high school students are still victims of society while college students realize that femininity is a quality and defies generalization such as short hair, etc."? Perhaps she is right. Certainly her study and the favorable parental responses shown in my own research would lead one to believe this to be so. Despite all criticism and uncertainties about female athletic competition, the majority of those surveyed in both studies said they would associate with girls who participate in competitive sports. Furthermore, the respondents thought sports competition a desirable activity for women.

Findings similar to these were made by Garman (5) in her research on attitudes. Although primarily interested in attitudes toward female softball players, she sought also to explore opinions about all female athletes. In surveying players, spectators, and the general public, she concluded that all groups showed slightly favorable attitudes--with players and spectators more favorable than the rest--toward competition; that the responders consider individual sports more desirable than team sports (a fact also brought out in my own study); that gymnasts are considered most feminine and softball players least feminine; and that all groups scored the player characteristic category lowest.

In the research done by Garman (5), Harres (6), and Sherriff (9) on femininity and athletics, player characteristics appear to be an important factor affecting attitudes toward the desirability of a sport. This is substantiated by the high correlation between somatic differences and preference ranking as shown by Garman (5). Also, it seems that sports like softball which utilize the more masculine skills of throwing, batting, and running are far less desirable for female athletic competition than gymnastics which emphasize delicacy and gracefulness. For some reason society does not appreciate that to perform either of these takes a great deal of power, speed, strength, and many hours of intense practice. Perhaps if *all* female athletes would remain soft-spoken, genteel, and demure on and off the field this gap between the various sports would close. This is especially important to the high school girl who has the ability and the desire to compete in a sport, but is held back because of the values placed on such activity by her peers, especially the boys.

In terms of values, what does all this research indicate? First it means that the general public still has some reservations about the importance of competition for women, but because the respondents so strongly believe competition a desirable activity for women it would appear that sports for women reflect the current philosophy that people should "do their own thing." Second, because spectators and players have more positive responses than the general public toward women in sports, there is reason to believe that a favorable attitude and participation probably go hand in hand. And last, this research underscores what might seem obvious--that in our society the concept of femininity is important. This last statement is supported not only by the criticism voiced by teenage boys, but in the reservations held by all respondents.

In conclusion, it is hard to pick any one factor as the main reason for the small number of female athletes engaged in competition. Perhaps the main obstacle is that sports competition for the female is still questioned as the "in" thing to do. Simply stated, if athletic participation is "in" it has a value, if not, it has little value. The question is how to achieve an "in" status. Possibly if we as teachers examine better the limiting factors that have no value, throw them out, and replace them with favorable factors such as sound physical education programs, increased opportunity, financial backing, feminine imagery, good equipment, good facilities, and

adequate number of skilled and feminine female coaches, the number of girls and women valuing competition in a sport would increase. Perhaps we need to go one step further and help students to understand and accept the value of being active in our sedentary and automated world. As physical educators interested in our nation and its people we have a responsibility to try.

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[1] This paper was presented at the American Association for Health, Physical Education, and Recreation Convention, Boston, Mass., 1969.

[1] The results are mainly from individual sports competitors (10).

[1] This paper was presented at the AAHPER Convention, Boston, Mass., 1969

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SECTION 2

PHYSIOLOGICAL ASPECTS

CHAPTER VI

THE FEMALE SPORTS PARTICIPANT: SOME PHYSIOLOGICAL QUESTIONS

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It has been pointed out that apart from menstruation, parturition, and lactation, there are no essential differences in the physiology of male and female, and the special anatomical characteristics of the female offer no bar to athletic sports.

This is an emancipated view. According to Harris (15), women were not allowed to compete in the ancient Olympic Games. The modern Olympics, when started in 1896, did not include female contestants. In 1968, at the XIX Olympiad in Mexico City, less than half of the countries (56 out of 115) included men and women on their teams. Of the 6,084 athletes, only 844 or 14 percent, were females. It should be pointed out, however, that at the XVIII Olympiad in Tokyo there was a total of 362 athletes representing the United States and 81 of these were women. And on the United States team at the XIX Olympiad in Mexico City were 393 athletes, 98 of whom were women.

There are certain special considerations which may help to explain, but not necessarily justify, why girls and women have not been encouraged or permitted to participate in athletics to the same extent as males. These considerations principally concern the menstrual cycle and pregnancy. Also important is fear of injury to the reproductive organs and the breasts. Certain other considerations deserve mention even though they have not been important, at least in preventing girls from exercising. They are: sex differentiation, use of birth-control hormones, and anemia.

In 1963, Astrand, et al, (4) reported their study of 30 Swedish champion girl swimmers and 84 former championship contestants (post-active group). The former had trained by swimming 3.78 to 40.4 miles per week; the latter group had averaged 5.6 miles per week. None of the 30 active swimmers was injured by that vigorous program, and the obstetrical and gynecological history of the post-active swimmers was normal.

Anderson (2) reported her study of synchronized swimmers at North High School in Des Moines, Iowa. The 65 swimmers were compared with 138 students whose swimming experience was minimal. The synchronized swimmers had less difficulty with dysmenorrhea and it was less severe as compared to the nonswimmers. She questioned 111 women who had

previously participated in vigorous athletic activity, and found that their obstetrical and gynecological history was normal.

The Pacific Association of the Amateur Athletic Union of the United States published a booklet entitled "AAU Study of Effect of Athletic Competition on Girls and Women" (27). The report contains data and opinion from virtually all medical and athletic disciplines. It contains no evidence that athletic competition has a deleterious effect on girls and women.

Erdelyi (12) surveyed 729 Hungarian women athletes and found that menarche, menstruation, and subsequent obstetrical history were not adversely affected by vigorous athletic activity. Indeed, the length of labor was shorter and the necessity for Caesarean section in athletes was 50 percent less than for the control group. Exercise has also been shown to be of benefit for those with dysmenorrhea (7, 14). Evalyn Gendel (13) reported the benefits of a postpartum exercise program on sedentary patients who experienced back pain following delivery.

There is little doubt that the hormonal cycle, which causes menstruation, may have a positive or negative effect on athletic performance. The time in the menstrual period when the effect is greatest is as variable as menstruation itself. It is generally believed that the premenstruum is characterized by diminished quality and quantity of performance. Within 12 to 48 hours after menstruation has begun and for a few days thereafter, performance is usually better than during the rest of the cycle. It should be remembered that these are generalities and that the many factors important in determining championship performance are undefined but are unlikely to be even moderately affected by whatever variation might occur during any phase of the menstrual cycle.

One rarely sees severe, uncontrolled menstrual cramps or the premenstrual-tension syndrome in Olympic athletes because women so affected would not be able to train to the extent required to attain a championship level of performance. This does not mean--and I wish to emphasize this--that a girl with either dysmenorrhea or premenstrual-tension syndrome should be discouraged from participating in athletics or even simple recreation. There are medicines and other types of therapy which will provide relief for both of these conditions.

With respect to strenuous exercise for women, I do not believe there is evidence available supporting the view that it is wise for healthy women of any age to indulge in a sport which is too strenuous for them. Although the literature contains many opinions stating that competitive events are harmful for women, there are no supporting data. The Division for Girls and Women's Sports of the American Association for Health, Physical Education, and Recreation states unequivocally, "DGWS believes participation in sports competition is the privilege of all girls and women." (1)

One may read that certain sports are suitable for women and girls, but others are prohibited because they involve the kinds of stress which could permanently damage the reproductive organs. Steinhaus (26) has discussed

this possibility, and McCloy (21), who made a preliminary analysis of the problem, quoted Paramore as follows:

> Dr. R. H. Paramore, who has experimented extensively in this field has called attention to the additional fact that the uterus is surrounded with structures of practically the same specific gravity as itself, and that it normally has no air spaces around it. Thus it floats free in a miniature pool of pelvic viscera, just as it might, if detached, float in a jar filled to the brim with water. Such a body suffers only such shock as occurs within itself and does not fly violently through the fluid when shaken. This can easily be proven by placing a raw egg in a liter jar filled to the brim with water and then screwing the top on in such a way as to exclude all air. No degree of violent handling that does not smash the jar will injure the egg.

This statement aroused my curiosity. I repeated Paramore's experiment and indeed the egg remained intact. This brief and simple experiment provides some insight into the built-in cushions with which nature has surrounded all of our internal organs. The brain is protected by this same sort of water cushion.

All of this supports the conclusion that the normal healthy female may participate in any athletic endeavor for which her training and experience prepare her. Quite obviously one may be injured in any athletic activity, but the basic point is that our organs are quite well protected and when the body receives a severe blow, the force transmitted to the internal organs is much less than that experienced by the surface of our body.

To some, it is a foregone conclusion that contact sports are forbidden for women, but the need for defining "contact sports" is obvious and until that is done, one is handicapped in discussing the matter. Margaret Coffey (9) has pointed out that basketball was one of the first acceptable competitive sports for young women in our country. Sport parachuting is not considered to be a contact sport, yet the decelerative forces experienced may be considerable. Nevertheless, critical studies have not been made and evidence is lacking that women are more prone to injury while parachuting than men (24).

The question of whether or not a young child, particularly a girl, should be allowed to participate in strenuous athletic activities is an important one. Establishment of the concept that physical exercise promoted health in children was set back for at least two generations by Beneke's (6) work reported in 1879. His data were misinterpreted by himself as well as most of those who read his report. It was generally thought that Beneke's study indicated that in the developing child the growth rate of the heart lagged behind that of the aorta and pulmonary artery. This anatomical myth was believed and quoted extensively. Finally, in 1937, Karpovich (19) pointed out that Beneke and subsequent authors had failed to compare the *volume* of the heart to the *cross-sectional area* of the aorta and pulmonary artery. Karpovich used Beneke's original data to demonstrate this point. He concluded:

1. Contrary to an established notion, there is no discrepancy between the development of the heart and the cross section of the largest arteries.
2. The heart volume and the cross section areas of the aorta and the pulmonary artery show a close proportionality. It would be of interest to use the heart capacity instead of the volume, but unfortunately there are not enough data available.
3. The ratio of the heart volume to the size of the blood vessel is not decreased at the age of seven. There is a steady gradual increase in this ratio which starts at the end of the first year.
4. Hygienic warning based upon erroneous interpretations should be discarded.

We do not have data which allow a precise and meaningful statement concerning which sports are suitable for various age groups. Even though it has been customary to prohibit prepubertal girls from competing, there is ample evidence that some girls have competed during and before puberty and have not been harmed by this experience. For example, the average age of the girls who were members of the 1964 U.S. Olympic swimming team was 15-1/2 and they had been competing for over 5 years (11). Obviously, many of the girls on the team had begun to train and compete prior to menarche.

That we will continue to see world records set by very young girls is borne out by the studies of Hunsicker and Reiff (17) and others (3, 8). Indeed, Hunsicker (16) has stated: "In performance tests demanding endurance or vigorous physical exercise the average score for girls reaches its peak between 11-13 years of age."

Wilmore and Sigerseth (28) investigated the physical work capacity of young girls 7 to 13 years of age and concluded after comparing their data with those available for boys of a similar age that there were no basic differences between the sexes in their physiological response to maximal exercise.

Macnab et al (20) have examined the hypothesis that men and women do not differ when maximum oxygen ventilation values are compared on the basis of fat-free body weight. They found that in all tests, maximal and submaximal, the male scores exceeded the female scores.

Whether or not females who have an excess of breast tissue will be at a disadvantage in sports participation, is largely determined by the requirements of individual events. One rarely sees a gymnast with extremely large breasts. Excess breast tissue would, however, be less of an impediment in other sports such as equestrian events, sailing, and some of the field events. With respect to protecting the breasts from trauma, there is no reason why, with engineering techniques available, proper protection cannot be provided. Bayne (5) has described a special protective brassiere.

A quick scientific test of whether a person is a male or female can be made from examining the cells obtained from almost any area of the body. It is convenient to obtain cells for examination by gently scraping the inside of the cheek with a blunt instrument and then spreading the material obtained on a slide. This material is then stained and examined under the microscope for the presence or absence of the so-called "Barr" body at the edge of the membrane surrounding the cell nucleus. Twenty to forty percent of the cells from genetic females will contain a small dark clump of chromatin material at the edge of the cell nucleus. The nuclei of cells from genetic males do not contain this chromatin material.

It is important to be certain that persons competing as females are actually females. The reason for this is that male hormones provide the stimulus for increasing muscle mass and do, therefore, give the male an advantage in certain sports. For this reason, the apparent female who is a genetic male or a male masquerading as a female should not be allowed to compete with women. There are many types of genetic abnormalities which would make a true male appear to be an anatomic female or a true female appear to be an anatomic male, but not very many of these allow normal growth and development to the extent which would permit the person to compete at the champion level. A female may develop an adrenal tumor which produces excess male hormone and changes in the secondary sex characteristics such as hair growth, voice changes, and loss of breast tissue. Even though this person might be mistaken for a male by the casual observer, she is actually a female Occasionally, a true genetic male will develop an abnormality of the testicles which will cause an excess secretion of female hormones. This person might very well appear to be a female, but would be an actual male and should not be allowed to compete as a female.

The use of male hormone will cause an increase in muscle mass in females. No coach, athlete, trainer, physician, or parent should permit this. The use of this type of hormone to enhance performance may endanger health both now and in the future. This is particularly true when male hormone is given to the female athlete who has not attained her full growth. It has the effect of prematurely stopping the growth of bones and the person involved would not attain her full height.

Once the menstrual cycle has begun, women require more iron in their diet than do males. Thus if a group of athletes adopt dietary habits which prevent their obtaining sufficient iron, the females will become anemic much quicker than the men. The anemia which would develop is easily treated by supplementing the diet with iron or by changing the diet to include iron-rich foods.

Do birth-control pills affect performance? Whether or not the hormones in them have the potential for enhancing or interfering with the quality of an individual's performance by altering strength, coordination, timing, or endurance is not known. To my knowledge, the subject has not been investigated in athletes. Morris and Udry (22) compared the

pedometer-measured activity of 8 women taking birth-control pills with 26 who did not. The former walked an average of 4.17 and the latter, 4.86 miles each day. These differences were statistically significant. The authors pointed out, however, that until a prospective study of women before and after taking the pills is done, their data will have to be regarded as presumptive evidence that the use of various hormone agents as contraceptives cause women to be less physically active.

The various metabolic effects of contraceptive steroids have been thoroughly discussed in the volume edited by Salhanick, Kipnis, and Vande Wiele (25). It would be somewhat surprising to find that these hormones did not alter performance. One other consideration—all contraceptive steroids are not alike in either their composition or effects. From the information available, if these drugs are prescribed for athletes, they should be given only those preparations which contain no more than 50 micrograms of estrogen. The reason for this is that the use of those formulations cause fewer side effects than those preparations containing larger amounts of estrogen (18, 10, 23).

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CHAPTER VII

WORK CAPACITY IN CHILDREN AND ADOLESCENTS

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Work capacity, the ability of an individual to perform muscular work, is usually measured in terms of energy cost to the body--how much the metabolic cost of a given amount of work exceeds the normal basal metabolism.

Since oxygen is required in the metabolic processes, measuring the amount of oxygen used by a subject has become a major method of determining metabolic cost. Another method of determining energy cost is to measure the response of the cardiovascular system to exercise. Usually, this is simply a matter of determining the peak-exercise heart rate. Although an indirect and less accurate method of assessing oxygen consumption, heart rate can be easily determined and is useful when comparing tests on a single individual.

The ability of an individual to perform work depends on a number of factors. The size of the individual's heart, for example, will affect the ability of the heart to push blood through the vascular tree. The amount of air that can be taken in and out of the lungs is limited by the effective lung volume. Vascularization affects the extent to which capillary beds are developed in areas where blood flow is needed. All of these factors are determined partially by genetic composition and partially by training.

The efficiency of the cardiovascular response, or cardiovascular fitness, is also a factor in work capacity. It is measured by determining how well the cardiovascular system, responding to exercise, supplies working tissue with oxygen. The less the heart must work for a given amount of exercise, the more fit it probably is. The fitness of the cardiovascular system is closely related to training.

Muscular development is another vital factor in the work capacity of children, who gain in muscular strength and mass as they grow. The more physiologically mature a child is, the more he is able to perform strenuous exercise. Physiological maturity is much more important in terms of work capacity than is chronological age. Although increase in muscle tissue depends on heredity and time, it is also subject to a degree of training.

Motivation is the most difficult factor to control. For people working with any age group, but especially adolescent or postadolescent girls, it becomes obvious that physical work capacity is highly dependent on motivation. A test of work capacity is often a test of tolerance of physical

discomfort. Most younger children don't have this tolerance and most adolescent girls won't have it by choice.

Body composition can be a major factor in determining the ability to do physical work. Exceedingly obese or malnourished children will be limited in performance. Among boys, the early maturers, who tend to be mesomorphic, generally have the greatest performance ability. Among girls on the other hand, those who mature late--who achieve menarche later and tend to have a more linear body type--generally perform better (8).

Three aspects of work are generally measured to determine energy cost of work: (a) the resting energy cost of the organism (basal metabolic rate) as measured by oxygen consumption, resting heart rate, blood pressure, temperature, and ventilation frequency; (b) the exercise cost of a given work load, which is the amount of oxygen consumed above the basal cost or the rise in heart rate, blood pressure, ventilation frequency, and temperature; (c) the recovery cost, or amount of time required for the body to return to basal level after termination of exercise.

Soon after birth the heart rate ranges from approximately 124 to 165 beats per minute. By age 7, the range is approximately 75-115 beats per minute. After age seven, there is a much slower decline through adolescence where the rate tends to level off at about 55-65 for males and 59-75 for females. The girls, after age seven begin to show a slightly higher heart rate than boys--a trend that persists throughout life (7).

Respiration frequency and body temperature also decrease throughout childhood until, at adulthood, these measures level off. Girls have a slightly higher body temperature which accounts, in part, for their higher resting heart rate. Basal metabolism also decreases with increasing age. Boys have a greater oxygen consumption than girls, even when paired for size and muscle mass. Blood pressure increases from birth to adolescence until it levels off at maturity (5, 6).

Heart and lung size generally increase in line with the physical growth of the child. In size and function, these organs seem to be normally distributed in the population and for the most part do not seem to be potential limiting factors in the work capacity of children. The greater lung capacity of males results from their greater thoracic growth during adolescence.

At all ages, heart rates increase linearly with the work load up to 160-170 beats per minute. Beyond this, adults begin to complain and children cannot keep the pace. The work capacity in adult males reaches its peak between ages 20 and 30 and males have a 30 percent higher level than females. This sex difference begins to appear at adolescence (3).

From ages 5 to 14, work capacity for a given heart rate steadily increases. Part of this improvement may be attributed to the greater range allowed for stress increase because of the continually decreasing basal rates from birth to adolescence. Peak heart rates at all ages are around the same, about 200 beats per minute. After age 30, the peak heart rate begins to drop (3). At all ages, from five through old age, the degree of physical

training produces differences in work capacity. Children at all ages are subject to cardiovascular improvement.

As the child matures, his strength actually increases more rapidly than either his muscle mass or linear size. The ability to coordinate and mobilize muscles must also be a factor, therefore. This could be, among other things, a result of innervation or vascularization.

Menstruation, in itself, apparently has no effect on the female ability to perform work, but it is the great catch-all and psychological bugaboo of women exercising. And, one cannot ignore the great cultural influence exerted on the female against exercise once she reaches menarche and "has become a lady."

At all ages children need vigorous, aerobic type activities if they are to make the most of their hereditary capacities. Even many children with cardiovascular impairments can participate in activity programs although their peak heart rates will be lower and they will fatigue sooner (4). Performance abilities which are not submitted to at least minimal training will soon deteriorate.

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CHAPTER VIII

COMPETITIVE SPORTS FOR GIRLS: EFFECTS ON GROWTH, DEVELOPMENT AND GENERAL HEALTH

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The question of the desirability of competitive sports for girls has been with us for more than 50 years and is likely to be with us for some time to come. The number of girls participating in interschool athletics has increased substantially in recent years and today highly organized athletic programs, comparable in many ways to those for boys, flourish in many of our states. Those who are charged with administering physical education programs need to know the effects of such programs on the present and future well being of the participants. It is the intent of this paper to summarize the research findings which bear these effects.

At the outset, it should be emphasized that our culture impresses on its young distinctly different patterns of behavior for the two sexes. It is not surprising, then, that the motor performance levels of boys and girls differ during the childhood years. These differences are not great and would seem to be almost as much a reflection of cultural as of biological differences. Clearly, the physical activity interests of boys and girls differ in the early elementary years and the differences become greater as time goes on. As sexual maturity approaches, marked sex differences in strength and motor performance are seen. At this time the biological differences between the sexes are sufficiently great to give boys a decided advantage over girls in activities that require muscular strength and power. Most of these differences stem from endocrine changes at puberty. In the female the development of muscle tissue tends to be inhibited at this time whereas in the male the growth of the muscles is enhanced. Biologically, the female cannot hope after puberty to achieve the level of most male athletes in activities that depend primarily on strength and power.

What then does research tell us about the effects of competitive sports on the growth, development, and general health of girls? The comments that follow will be directed to the immediate and more lasting effects of participation in those sports that place a heavy demand on the physiological mechanisms of the girl, namely such sports as swimming, track and field, and basketball. No reference will be made to contact sports, or physical activities which by their nature are not appropriate for girls or young women.

GROWTH AND DEVELOPMENT

While there are only a limited number of studies in which girls who have been regular competitors have been observed over a period of years, the evidence indicates that such training and sports competition have no adverse effect on physical growth. For example, year by year observations of girl swimmers who began heavy training as early as 10 to 15 years of age have indicated these girls suffered no growth impairment and in fact showed slightly accelerated growth over their untrained counterparts. It should be pointed out, however, that girls who are attracted to this type of activity are usually blessed with excellent health and hence the accelerated growth, caused as much by an innately rugged constitution as by the rigors of training.

SPORTS PARTICIPATION DURING THE MENSTRUAL PERIOD

Evidence to date indicates that the danger of permanent damage to the female organs from strenuous exercise during menstruation has been exaggerated. Some authorities point out the possibility of damage to these structures from excessive jumping and jarring, particularly during the early part of the menstrual period, but evidence in support of this is scanty. For some girls, however, the premenstrual symptoms, both nervous and emotional, may be exaggerated by a variety of stresses, including those generated by the physical and emotional strains of competitive sports. Without doubt variations among girls in these respects are great.

The literature is in general agreement that for the majority of young women physical performance itself is not materially affected by the menstrual period. There is, however, some evidence that performance levels tend to be somewhat poorer in the premenstrual and early menstrual period, showing improvement during the latter part, with the best performance in the postmenstrual period.

Research is in general agreement that the age of menarche of the young girl athlete is not different from that of the nonathlete. There is, however, evidence to indicate that girls who start intensive athletic training before menarche have a higher percentage of menstrual disorders than those who start training later. Such disorders tend to disappear with a reduction in the work load. Present research indicates that gynecological problems occur more frequently among competitive girl swimmers and skiers than for those in other sports. For example, over-training and excessive stress in the female athlete has been cited in several studies as a cause of menstrual disorders.

CHILD BEARING FUNCTIONS

There is little if any evidence to indicate that childbearing functions of women have been adversely affected by participation in competitive athletics during adolescence. In fact, most studies show that young women

who have engaged in athletic training are less likely to have complications during pregnancy than nonathletic women. The duration of labor has been shown to be considerably shorter in the former girl athlete than in control subjects. Many authorities hold that, in the female athlete, the musculature of the abdomen and of the pelvic floor is better equipped to handle the problems of labor than in the nonathlete.

MASCULINIZATION

Some hold that heavy athletic training in the female brings on signs of masculinization. While there is some evidence that girls with masculine characteristics tend to become involved in competitive sports more frequently than those with feminine characteristics, there is little evidence to indicate that athletic participation in and of itself brings on masculinization. Few would be inclined to categorize the female dancer or swimmer as showing masculine characteristics. On the other hand research has shown that girls who fall on the masculine end of a somatic androgeny scale (masculinity-feminity scale of body build) are stronger per pound of body weight than girls who are at the feminine end of the scale.

There are some who feel that sports competition reduces the girl's chances for marriage. The data simply do not support this point of view. While facts on this are limited, studies from Europe indicate that female athletes marry as often and at approximately the same age as nonathletes and have their first babies at about the same age as nonathletes.

PHYSIOLOGICAL FUNCTIONS

The physiological effects of training on the young female are much the same as on the male. While the female seems to be somewhat more resistant than the male to the development of muscular strength and power, the adaptations of the heart and respiratory system to heavy training are similar in the two sexes. Interestingly, world records in several swimming events formerly held by men have in recent years been surpassed by adolescent girls.

Followup studies on women athletes indicate that their body weights more nearly approximate the ideal weight, not only during the period of training, but also in the years that follow. From the standpoint of general health and physiological functioning, then, the female athlete is clearly superior to her sedentary counterpart.

PSYCHOLOGICAL AND EMOTIONAL EFFECTS

It is often stated that girls and women are not by temperament suited for competitive sports. While there may be some truth in this, studies of young women athletes do not bear this out. While admittedly data are meager on this matter, evidence now available indicates that girls who have

participated over a period of several years in highly competitive individual sports are as well balanced psychologically and emotionally as non-participants. Of course, when long hours of training meet with limited success the resulting frustrations may have psychological consequences. If these do occur, the research has not brought them to light.

QUESTIONABLE PRACTICES

The foregoing has tended to support competitive sports and rigorous athletic training for girls and young women. There are, however, other considerations which should not be ignored. The conditions under which such programs operate are in many instances far from ideal. For example, it is not uncommon in many schools for girls to be under the direct supervision of a male coach. A recent study in one of the midwestern states indicated that of the high school teachers dismissed for immorality, almost 50 percent were male coaches discharged for improper relationships with members of their girls basketball team. One might ask why is it necessary for men to serve as coaches of girl athletic teams? Most certainly there are many women qualified to serve in this capacity. Where it seems necessary to employ men coaches, it is clear that there should be a female sponsor working closely with the male coach.

One cannot ignore the fact that long hours are required for top level athletic performance, time that for many might be more profitably used in other ways. This is particularly true for the young girl who is not yet mature enough to commit herself to a sports specialty. Reports of women who in their youth trained long hours for national swimming championships indicate that many question the advisability of long and rigorous training practices.

There is an increasing possibility in athletic programs for girls that funds and space will be directed to the talented few at the expense of those who need activities most. This has been one of the major difficulties associated with competitive athletics for boys, and many women see this as a distinct possibility once competitive sports for girls gains a foothold.

CONCLUSIONS

There is much yet that remains to be learned about the effects of highly competitive sports on girls and young women. While one cannot ignore the possibility that the physical and psychological stress of competitive sports may not be in the best interests of girls, the evidence to date indicates that the health of young women is not impaired by heavy training and, in fact, is likely to be enhanced by rigorous athletic programs that are properly supervised. However, to give full endorsement to highly competitive sports for girls at this point would not seem to be justified, for there are philosophical and cultural considerations which may be just as important as those that have been discussed.

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CHAPTER IX

WHICH SPORTS FOR GIRLS?

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Girls take part in sports to different degrees—from simply observing, through casual, occasional participation, to all-out daily training for top-notch competitive events. We are not concerned here with the girl who dabbles in sports, although such participation is of course beneficial if it is fun. It is the more strenuous, serious competitive type of sports participation that we are interested in examining. Naturally, it too is beneficial if it is fun. But it also raises some difficult questions: What sports are suitable for girls? Are any sports strictly unsuitable for girls? Are any sports dangerous for girls to take part in? Are competitive sports appropriate for girls? A summary of the status of sports medicine can give us an idea of our progress in finding physio-medical answers to these and other questions concerning athletics for girls.

Sports medicine is a relatively new, rapidly growing branch of medicine in this country. It deals with the physiological changes occurring in sports and training, the treatment of sport injuries, and the role of exercise in preventive medicine. Although work is being done by a great many individual researchers throughout the country, lack of centralization has made the records of many studies unavailable. There are three main bodies of sports medicine in the United States: the American College of Sports Medicine, the American Medical Association Committee of Sports, and the new center at the University of Wisconsin, which is the only institute of sports medicine we have. A year ago, for the first time, a *Journal of Sports Medicine* was started in this country. Previously all we had was the *International Italian Journal.* There is still a problem as far as funds for research go. I hope that the Child Health and Development group of the National Institutes of Health will do some of the studies on the effect or dangers of physical stress for children.

Although other countries have been ahead of us—especially Italy with its fulltime doctors in sports medicine and Japan with its many studies—we are now making excellent progress and are catching up. More and more we are joining them in international conferences for exchange of ideas in sports and training.

The body responds to sports, exercise, and physical stress by becoming fit. To attain some degree of fitness one must perform the game or exercise at least thirty to forty-five minutes three times a week for six

weeks. This is an encouragingly brief period of time for those primarily interested in sports for fitness. But for many, fitness is simply a happy by-product of enjoying a sport.

Fitness immediately suggests firm muscle tone, suppleness, and endurance. In effect, it is the condition of the body necessary for working at maximum efficiency; a fit body is like a well tuned engine. Because doctors tend to take as normal what is average, the parameters for healthy blood pressure, pulse, respiration, respiratory capacity, and muscle strength are more descriptive of the unfit individual. Perhaps we should use as parameters what is normal for fit individuals. A fit person has a slower pulse, lower blood pressure, lower respiratory rate, deeper respiration, larger heart, and stronger heart stroke. The heart pushes out more blood with each beat. The fit person can tolerate oxygen lack longer than the unfit. Recovery from exercise is more rapid. The heart rate returns to normal more quickly after exercise.

These differences enable a fit person to function better in her daily routines, to get less tired at work and to require less sleep at night. It is irritating that just when we need fitness to help our endurance in everyday things most, we have the least time to take part in the activities that make us fit.

Fitness--and the feeling of exhilaration that goes with it--are as natural for girls as for boys, and for women as for men. Fitness and exercise are actually a treatment for dysmenorrhea and are a definite help in childbirth and in recovery in the postpartum period. They are also handy when one has small children to take care of!

But what about the extreme fitness required for rigorous competitive sports such as the events of our young Olympic swimmers? Though it may be necessary for success in international events, what does it do to a young girl's body? Three questions jump to mind: First, what are the long-term results and possible dangers of such severe physical stress? Second, can a child alter her feminine build with rigorous physical exercise? Third, can she push herself beyond what her body can endure?

We all have heard the concern, "Oh, dear, I hope she doesn't end up with enormous shoulders and arms from all that exercise." But in defining fitness, I quickly see parallels to the definition of femininity: suppleness, grace, ease of motion, good carriage, rhythm in motion, and balance. The muscle-building type of exercise, such as weight lifting, does not suggest itself to any of us as suitable for girls, partly because a woman would not look attractive performing and partly because she would have to look unattractive to us if she had the muscles she'd need to perform well. While this kind of exercise would not cripple a woman or decrease her ability to keep house well, it certainly would not add to her feminine image.

Bone is molded during growth and repair by the muscle's pull on it. Theoretically then, one could alter bone structure perhaps permanently through frequent stressful exercises. Yet we have no statistics on this. Muscles, and presumably bones, generally return to their pre-stress state in

six weeks to two months after routine exercise has ceased. Studies with proper controls would be difficult to carry out but records of long-term observation might shed some light on this subject.

Diseased bone, especially young bone, can be permanently molded. Healthy bone can too. Because of this, exercise and fitness are as necessary to humans as they are to felines. Also, I continue to cringe at shoulder-building sports for girls. In training for physical fitness tests, push-ups over a six-week period are justified, but push-ups for twelve months of the year are unnecessary.

We certainly are influenced by our culture and times in what we think is feminine. It is natural that our sports, which involve self-expression and the release of feelings and emotions, should reflect this. We are probably less narrow-minded now, and should be, concerning which sports have the grace, suppleness, and rhythm compatible with femininity. One coach stated that in spite of the fact that our young girls are such wonders in Olympic swimming competition, swimming won't be accepted as a good sport for a large number of girls until *Vogue* magazine comes out with hairdos that won't be ruined by bathing caps. However, men may have this problem too if long hair styles continue.

The more I try to list sports that are suitable for girls, the harder I find it. What seems to matter most is the attitude a girl has toward a sport and what she does with it. Perhaps if people actually realized the extent to which endurance and physical strain are involved in skating or dancing, these so-called gentle sports would also be considered unsuitable. I never considered discus throwing feminine until I met Olympic champion Olga Connolly. Since meeting her, I have never been able to say anything against it. Not until recently did the thought of women jockeys enter my mind. But Mary Clayson, in showing that it suits her and doesn't detract from her, has made it seem suitable.

Perhaps we could consider as unsuitable for girls those sports in which girls would do better if they received masculinizing hormones (as actually has happened in some international track events). But we know that track events can be graceful. We have only to see Wyoma Tyus and some of her track contemporaries to know track can be a feminine sport. Girls set lower records than men. If we accept this as being a result of differences in overall size, heart size, and bone structure, we can accept track as having both masculine and feminine attributes, according to whether it is being performed by men or by women.

The mock-fighting, aggressive, body-contact sports still do not fit our picture of the typical young American girl, and I hope they never will. The qualities of gentleness, of administering to others and being considerate of their feelings, the protective maternal instinct—all of these are foreign to such sports.

There are reports that persistent chronic stress causes hypertrophy of the adrenal gland (an endocrine gland that works in conjunction with the thyroid, the ovaries, and the pituitary gland to regulate the metabolism,

growth, and emergency reactions of the body). One wonders if persistent stress can throw out of balance the normal interplay between these glands. So far, reports show that adrenal hypertrophy is reversible after the stress is stopped. This has been done in rats by forcing them to swim to the point of exhaustion. Perhaps and probably it applies to human beings also.

An immediate danger of competitive sports is injuries. Actually, fewer injuries occur in fit individuals. Even though they may be taking more chances by doing more, their reflexes and proprioceptive responses are far superior to those of unfit individuals. While I state this I am acutely aware of exceptions and cannot help recalling an incident that occurred at the World Figure Skating Championships in Colorado Springs not long ago. A top contender, the first ranking Canadian girl, 16-year-old Karen Magnuson, developed severe pains in her lower legs. Initially it was thought to be shin splints, for she had had no injury. She was treated with heat and bandaging. One evening I watched her during a practice session in which she skated so well that in spite of being medically oriented I didn't even notice her bandages. At the end of the practice session, she came off the ice quietly, but with tears in her eyes. She confided that her legs were terribly painful, even during walking. Our natural reaction after seeing her wonderful skating was to encourage her and to advise her to do no more than limber up before the competition two days later. The following morning we were shocked to hear that x-rays taken late that night showed we had been watching her skate on two broken legs. The bones were split, and fractured, though not displaced. No one knows whether it happened while we watched her skate or beforehand. Apparently the tremendous increase in training time in the four to five weeks before competition, the increased weight of her legs, and the youth of her bones created a situation where her muscles were so strong they pulled her bones apart in a manner similar to what can happen in two-year-old race horses.

Karen's legs bring up the question of whether an athlete, especially a child, can actually push herself beyond what her body is capable of standing. Can her motivation push her too far? Usually, no. The legs will give out before the heart; that is, a person will stop the exercise before there is heart damage. This, of course, applies to healthy, normal individuals, and is one reason for the stress on physical exams to detect heart defects before a child enters sports.

It is amusing to stop and think how out of keeping it is for us to worry about how much physical activity girls have, when no one has ever worried about how hard a woman has to work keeping house, helping to run a farm, beating laundry in a cold stream, carrying water, protecting her children, pioneering across this country hundreds of years ago. As long as it is something within her role in the family, it seems all right. Why the stigma on those who participate in sports? As long as she enjoys it and in some way it helps her fulfill herself, it is wonderful and healthy for a girl to participate in a sport she chooses.

Sports fill a need in us--a need to express and measure ourselves in life. They are a microcosm of the real world. The sports world has definite rules and boundaries which make it easier for us to know where we stand. It has definitions and limits which we might wish were as clear in the everyday world. Also, sports fill the need for motion and activity, which, in some societies, is taken up by the struggle simply to gather food and survive. In addition to the joy, exhilaration, and abandon of participation, sport develops fitness, and fitness in turn helps one be more efficient in day to day living. Scholastic performance is also improved with physical fitness--perhaps partly by making one's whole being more alert and partly by the training in self-imposed discipline which the athlete is able to apply her studies.

In conclusion, doors are continuing to open for women in sports, and the limit should be what the girl sets for herself. The safeguards are pretty much built right in.

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CHAPTER X

FAT—FACT AND FALLACY

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To the overweight adolescent the problem of obesity is neither an academic nor a scientific one; it is a very real, very personal problem with complex physical, social, and cosmetic aspects.

It is to the physical educator that these students often turn for guidance and assistance, and if our advice and our programs are to assist this group, we must be familiar with the facts and fallacies about fat.

ENERGY BALANCE

The basic concept of energy balance is quite simple. It states that the weight of a given individual is the result of caloric intake (diet) and caloric output (activity). If the intake exceeds the output the individual is said to be in a state of positive energy balance, which means she is gaining weight. If the output is greater than the intake the individual is said to be a state of negative energy balance and is losing weight. If the caloric values of the diet and activity level are equal the individual is in a state of energy balance and weight remains quite stable.

WEIGHT LOSS

To lose weight a *negative energy balance* must be established. That is, the caloric requirement of the individual's activity must exceed the caloric supply of the diet. Theoretically then an individual's weight can be decreased by (a) limiting the caloric supply (diet), (b) increasing the caloric output (activity), or (c) combining an increased activity level with a decreased diet. The actual rate of weight loss over a period of time is determined by the caloric difference between the intake and the output—the greater the difference, the greater the weight loss. A loss of approximately 3,500 calories is necessary to lose one pound of weight.

The reader may immediately be aware of an apparent "credibility gap" between the basic logic of energy balance presented above and the actual utilization of this concept in most weight control programs. It is a well accepted fact that restricting food intake (dieting) will cause a weight loss—providing of course the individual is willing and able to adhere to the terms of the diet. It is, unfortunately, an equally well accepted *fallacy* that

weight cannot be lost by increasing the activity level! Two "reasons" are usually cited: first, exercise doesn't really use up many calories; and second, when you increase your activity level you also increase your appetite and in the end will simply eat more. On occasion a mild activity program may be recommended in conjunction with a diet--not as a method of creating a greater negative energy balance and therefore a more rapid weight loss--but as a means of toning up the flesh, getting rid of wrinkles, or improving circulation. Exercise, it would seem, is good for the appearance and good for health, but is of little or no value in establishing and maintaining the negative energy balance needed for weight and fat reduction! Sound familiar? It should! But in reality, it is one of several fallacies that should be clearly understood by anyone concerned about the role of activity in weight control. Some facts are presented below.

THE CALORIC VALUE OF EXERCISE

Most people know that foods can be measured in terms of calories. Many people do not realize that the caloric value of a food is really a measure of the amount of heat (energy) that a particular food is able to produce when it is oxidized or "burned" in the body. Because all forms of activity require energy, it is possible to measure that requirement in terms of calories also The greater the caloric value of a given food, the greater the energy potential of that food; the greater the caloric value of a given exercise, the greater the energy requirement of that exercise. The equality of the food calorie and the exercise calorie make it possible to make direct comparisons between foods and activities. The caloric value of a pound of weight lost is usually set at 3500 calories even though the caloric value of a pound of pure fat is over 4,000. The difference may be accounted for by the water and other material that is included in the pound of weight lost.

The continued belief that activity expends relatively little energy is difficult to understand--it is completely without basis in fact! The following caloric values are approximate figures for a 125-pound woman. All caloric values are expressed on a per-hour basis. If approximate values are desired of other weights they could be found by dividing the new weight by 125 and then multiplying the given caloric value by the result.

When our 125-pound young woman is sitting quietly in a chair she will be using about 70 calories. Having her do strenuous *mental* work as she is sitting there would add only two calories per hour to that requirement! Standing quietly increases the total energy cost to about 85 calories. Walking at 3 miles per hour (an average speed for women) requires 225 calories -more than three times the energy required for sitting and thinking! A relatively fast walk of four miles per hour will use up nearly 290 calories and a slow jog of five miles per hour will require about 450. Energy requirements for swimming can vary from about 240 calories for a slow breast stroke to over 600 calories for a fast crawl stroke. Bicycling at six miles per hour will use up about 190 calories, but if the

speed is doubled to 12 miles per hour the caloric cost goes up to a little over 400.

The caloric cost of sports activities really depends on the activity level and the skill of a given player but the following figures may serve as a rough guide: bowling–100; archery–165; golf and ping pong–250; tennis and badminton–420; and fencing–450. A major advantage of participating in a selected sports activity is a tendency to spend relatively long periods of time in those activities. Two or three hours on the golf course or tennis court is not at all uncommon.

Why then is the average person so convinced that exercise for weight control or reduction is not practical? A glance at almost any publication that mentions activity and weight control provides the answer. The "facts" are there–but presented in a manner that exhaustion could result just from reading what one must do . . . *in orde to lose a pound.* For example, our 125 pound women would have a choice of walking 47 miles at three miles per hour; jogging 39 miles; bowling for 35 hours; playing golf or ping-pong for about 14 hours; playing tennis or badminton for a little over eight hours; or fencing for a little less than eight hours! It's enough to scare a person in good condition, much less an individual not in particularly good condition and wanting to lose a bit more than *one* pound.

These same "facts" could be presented quite differently, however. For example, by walking only a half hour a day our 125 pound women would still lose a pound every month or nearly 12 pounds in a year. By jogging (or running-in-place at the same speed at home) for just 15 minutes a day, she could accomplish the same thing. If she prefers sports, then she could play tennis or badminton for two hours a week. Of course an individual weighing more than our 125-pound example would use more energy in these activities and her weight loss would be proportionately larger. Thus, how the "facts" are presented can be more important than the actual figures.

ACTIVITY AND APPETITE

The second fallacy–that any increase in activity will be followed and offset by an increase in foot intake–is more difficult to disprove. Actually, in the broad range of "normal activity levels," there is a clear relationship between activity and foot intake. The fallacy lies in the assumption that since a close relationship exists in the normal activity range that it must therefore exist at *all* activity levels. It does not. In both humans and lower animals, when activity levels are high enough to cause a state of exhaustion, the food intake drops below the body's requirements and weight and fat are lost. However, activity levels high enough to cause a state of exhaustion are practically unheard of in our modern society. Very few women ever exercise at a strenuous level; most of the activities in our physical education programs would have to be classed as mild to

moderate—even those activities we consider rather demanding. Women and girls are capable of exercising at extremely high levels. It just seems that most of us find less strenuous activities more enjoyable.

More recent studies on the relationship of activity to appetite have shown conclusively that the appetite control system also fails to function effectively when activity levels are quite low. The failure of the "appestat" at low activity levels has been demonstrated in both humans and lower animals and should be considered whenever low activity levels are encountered. The very practical effect of the failure of the "appestat" is that the individual at the so-called "sedentary activity level" overeats. In fact, the sedentary individual *often eats more* than his counterpart who is engaged in light to moderate activity! As a result, he soon becomes overweight. An increase in his activity level will not necessarily mean an increase in food intake. It could even result in decreased food intake. In either case, the increased activity level would contribute to a negative energy balance which would result in a loss of weight and fat.

THE RELATIVE IMPORTANCE OF ACTIVITY AND DIET

Are people overweight because they eat too much or because they are underactive? Numerous studies were reviewed and their composite results are quite revealing.

Diet. Although most overweight individuals seem to consider overeating a primary cause of their difficulty, in no study were the recalled dietary intakes of the obese or overweight higher than those of their normal controls, and in several of the studies the average caloric value of the food intake of the overweight individuals was less than that of their normal counterparts. Dietary recall, even with parental assistance, has several sources of potential error. However, the apparent consistency of the results of these studies would seem to point out that the overweight individual does not eat more than the normally weighted person, and may actually eat less!

Activity. Obese and overweight individuals give strong verbal approval of activity and sports and when questioned regarding their participation they report that they participate in equal numbers of moderate and strenuous activities and spend as much time in those activities as their average-weighted peers. However, obese adult women have been shown to have greatly overestimated their activity levels and in all studies where activity was actually measured, overweight subjects were actually less active on the average than their controls. This was the case even when the overweight and the normal subjects spend the same amount of time in the same activities. It has been suggested that the greater bulk of the obese individuals might tend to equalize the actual energy expenditure of the two groups, but again, the consistent theme throughout these studies is the

lower activity level of the overweight individual—in spite of his apparent belief that he does actually take a more active role and in spite of his apparent positive attitude toward activity.

EFFECTS OF INCREASED ACTIVITY ON THE OVERWEIGHT

A negative energy balance is needed if weight and fat are to be lost. Activity has been shown to be a potential contributor to a negative energy balance by increasing the caloric output of the individual. Research has also indicated that increased activity levels will not necessarily result in an increase in appetite or food intake providing the individual is inactive enough to be in the "sedentary" group. Today's average person is relatively inactive; the obese individual is less active than the average and is therefore a strong candidate for the sedendary group.

What happens when the activity level of the overweight or obese individual is increased? Obese, sedentary rats show weight and fat losses when subjected to a moderate exercise program (running or swimming). Studies also reveal a decrease in food intake as the animals move from the sedentary activity level to a moderate activity level. After the moderate level is reached, food intake increases as activity increases.

Such complete control of overweight or obese human subjects is usually impossible. However, in one study where the subjects were actually confined to a hospital during the experiment, it was possible to measure the effects of a carefully monitored exercise program and to compare them with the effects of lower activity levels. Although the subjects in this study were also on carefully controlled diets, the authors concluded that the exercise added to the dietary program *clearly contributed to body weight and fat loss.*

If exercise can clearly contribute to weight and fat losses, can increasing the activity level alone also cause these changes? At least one study indicates that it can. A group of overweight college women volunteered to take part in an eight-week jogging program and at the same time agreed *not* to change their food intakes. Significant amounts of weight and fat were lost during the program even though all of the subjects felt that they were eating more at the end of the eight weeks than they had been eating at the beginning of the exercise program. Similar results have been reported for overweight girls attending summer camps where rather high activity levels were imposed. Relatively successful weight-control programs have been conducted in both high schools and colleges where increased activity programs have been combined with some dietary assistance. Increased activity levels will definitely contribute to a negative energy balance when used in conjunction with dietary restrictions and can cause significant losses of weight and fat in both animals and humans even if no dietary restrictions are imposed.

WEIGHT-CONTROL PROGRAMS

Weight-control programs can be developed for inclusion in the normal school program. Facilities, time, and equipment may impose certain restrictions on the basic format of a specific program but need not prevent the organization and development of a good, continuing weight-control class or club.

The need for a program of this nature becomes obvious when a few facts are considered. We do have many overweight and obese students in our classes. The social and cosmetic problems of the overweight student are well-recognized—it really isn't much fun to be fat. There are even some indications that being overweight can be an influencing factor in being refused admission to some colleges. The health problems associated with obesity also clearly indicate the value of losing excess fat as soon and as permanently as possible. Present research indicates that the overweight student has a very good chance of becoming and remaining an overweight adult. The obese student knows that he is obese—and most of them honestly want to do something about the problem. This tremendous desire to do something about being fat makes the overweight individual the target of a vast quantity of inaccurate information: secret diets (for sale of course) that will work when all else has failed; pills or candy that will let you eat all you want but still take off "ugly fat"; books that sell millions of copies by claiming to reveal new, easy ways to slimness; reducing salons that promise inches lost in minutes and effortless exercise via machine. Sponsored or associated with well known or authorative names or institutions or degrees, wrapped in pseudo-scientific terms and reinforced with impressive "statistics from scientific studies," the fat fallacies are almost overwhelming! Even well-educated, mature individuals find it difficult to identify fact from fallacy—and how much more difficult for the emotionally involved young person! As educators we have an obligation to make the facts available. As physical educators perhaps we have an obligation to make available a program that will give those students an opportunity to actually *do* something about the problem.

Although weight-control programs may vary considerably in actual content and format, experience suggests that some elements be included in all programs. There should be regular meetings of the group (at least once a week—more often if possible) in an area that permits both privacy and room for activity. A progressively more difficult program of activities should be made a part of these regular meetings. Measurements should be taken on a regular basis and individual and group records and charts should be kept. A diet of a moderate nature should be obtained from local nutritional or medical personnel and made available to group members. When working with students who neither plan nor cook the family meals, a diet that permits choices from groups of foods rather than one requiring very specific items is preferred. Good reference books on caloric content of specific foods should be available. In addition, *accurate* reading materials which are concerned with specific problems of the overweight or

obese should be made available (some references are suggested later). Dietary record sheets are interesting and often help serve as reminders; if kept accurately they may also indicate food habits that are preventing weight loss should this become a problem in a given case. Outside activity levels should be increased and encouraged. An activity record sheet is a good project and analysis of these records on a caloric energy expenditure basis is an excellent method of pointing out the value of activity. Club or class projects such as a collection of special recipes or weekend hikes can be of value. The sponsor of this group must be very familiar with "facts and fallacies" and in addition must be a reasonably strong leader.

Can obesity be corrected? Of course! *Will* a specific individual be able to lose excessive fat? Perhaps! Experience with weight-control programs has convinced the writer that there are some individuals who *need* to be fat. If there were an effective way for us to separate the fat body from the fat person(ality), there would be no continuing problem of obesity. We would control the diet, increase the activity level, give needed assistance to underlying postural problems, and within a few months the fat bodies in our charge would be at or approaching ideal levels. Unfortunately we cannot always deal with just an overweight body. We must recognize that occasionally we are going to work with an overweight or obese person. This does not mean that the concept of energy balance no longer applies—it does apply but the energy balance will be influenced by the overweight individual. Some individuals will give every indication of a sincere desire to lose weight and yet give every appearance of being unable to do so. This can be so convincingly done that you may seriously begin to doubt the whole concept of energy balance. In these cases you will be dealing with the individual who, for whatever reason or combination of reasons, needs to remain fat and yet is under a certain amount of pressure to appear to desire to be normal. These people need assistance of a nature we are not qualified to give.

We can perhaps understand this person a little better if we stop to realize that there are certain very definite advantages in being fat. For example, being fat automatically excuses one from having to attempt many difficult physical skills—the fat person just isn't expected to run fast, jump high, or move skillfully. In fact, excessive obesity has been given as a medical reason for excusal from physical education classes. Since excessive fatness is generally considered basically unattractive, the fat individual is not expected to be sought after as a dating partner. Excessive fatness, and the more obvious results of that fatness, often make the fat individual an object of sympathy—particularly within the immediate family. The group sponsor who would deal effectively with the obese individual must understand this basic need (whatever the actual cause or causes) of some people to remain obese. Being fat can be an excuse for not being many things! These individuals are in a minority, however, and the great majority of those who join weight-control groups are quite sincere in their desire to join the normal world.

RELATED INFORMATION

What is fat? Chemically the fat or lipid molecule is a combination of an alcohol and fatty acids. The formation of the fat molecule in the body involves two general procedures: the actual formation of the fatty acid chains, and the attachment of these chains to the alcohol. During the digestive processes, *all* classes of foodstuffs (fats, proteins, and carbohydrates) can be broken down into a two-carbon unit of acetic acid. It is this same unit that actually forms the "links" in the fatty acid chains which eventually can unite with an alcohol to form a molecule of fat. This information is important as a basis for understanding that excess calories *from any kind of food* can be used by the body to build fat. Body fat is retained in special fat cells and the collection of these fat cells are referred to as adipose tissue.

What does fat do in the body? Fat serves many purposes. Along with sugar, it is fuel for the body. Energy is obtained when the carbon chains of fat and sugar are "burned" or oxidized, and carbon dioxide and water are formed as waste products. Internally, fatty tissue surrounds and supports many structures and organs. Adipose tissue is also distributed over the surface of the body just below the skin. This subcutaneous layer of fatty tissue (sometimes calles the *panniculus adiposus*) gives surface contour to the body, acts as a protective shock-absorbing cushion for organs and tissues lying beneath it, and serves as an effective heat insulator for the body.

How much fat is normal? In an average young man, fat makes up 12 to 18 percent of the body weight, but in the average young woman the percentage increases to 18 to 24. At all age levels women tend to have a greater percentage of fatty tissue than men. In both men and women there is a definite pattern of increasing fatness associated with increasing age. Very thin persons may have as little as 5 percent body fat while in very obese individuals body fat may exceed 70 percent. In the thin individual almost all of the fat is stored internally. As more fat is accumulated, a greater percentage is stored in the subcutaneous fatty layers. In obese persons this can amount to almost 70 percent of the total adipose tissue.

How is the subcutaneous fat distributed? Subcutaneous fat not only varies in the absolute amount present but also in distribution. Women, being normally "fatter" than men, tend to have thicker layers of subcutaneous fat. Among other things this gives women a more rounded figure, and because the additional fat also acts as an insulator, women seem able to survive snow storms in nylon stockings and short skirts while men require long underwear and wool pants. In general the subcutaneous fat is thinnest near the hands and feet, gradually increasing in thickness as the trunk of the body is approached. In both men and women there appears to be a great deal of individual variation with regard to *where* the most fat is stored. In women, the thickest layers of fat seem to be found in the hip region, just below the crest of the ilium. The thigh, abdomen, and

calf of the leg follow the hip in thickness of the subcutaneous fatty layer. In overweight young women, the absolute amount of fat present in the subcutaneous layers increases, but the relative locations--hip, thigh, abdomen, and calf--do not change. Reduction of these overweight young women lowers the absolute thickness of the subcutaneous layers, but again, the relative thickness at these four sites remains. In older women, there seems to be a tendency for additional fat to be stored in the trunk areas--chest, back and side--while the layers of fat over the lower limbs tends to diminish and the amount of fat in the upper limbs seems to remain relatively stable Overweight young women also appear to store much of their excess fat in the waist area. This particular site appears to give up the excess fat rather rapidly when weight is lost. Young men seem to carry their subcutaneous fat rather evenly distributed over the various trunk sites, but as excess fat is accumulated in older men, the additional fat is stored primarily in the chest, back, and abdomen. Unlike women, men do not seem to store additional fat at the waist. Heredity appears to play an important part in "fat patterning." During a period of weight and fat loss, losses from various body locations do not proceed evenly--either in absolute or in relative terms. It is not uncommon for an individual to seem to "refuse" to lose excess fat from one place--the hips for example--even though fat losses are quite evident in other places. In time, changes do occur, but our understanding of the specific processes involved is far from complete. One thing is quite evident: *if a negative energy balance is established and maintained, fat losses from the body will be effected and these losses will be in direct ratio to the difference between the body's caloric requirements and the body's caloric supply.*

Are weight losses and fat losses the same thing? No they are not. Fat loss refers to the actual decrease in body's store of fat tissue. Weight loss refers to changes in total body weight, which may include changes in the fat tissue, but which also include any of a number of less permanent changes. Lunch could add a pound or two to an individual's weight while an hour's exercise in the sun would cause an equal loss in weight. It is quite well documented that fat losses tend to be quite steady and related directly to the negative energy balance referred to previously. Weight losses are far less predictable, however, and so-called "plateaus" of weight stabilization--even in the presence of a definite negative energy balance--are not at all uncommon. The usual explanation for the relative unevenness of weight losses revolves about the body's ability to retain rather large quantities of water. Excess water can be retained for several days then released quite suddenly. The scales would then show a sudden weight loss associated with the water loss. Release of intra- and intercellular water is also responsible for the sudden, dramatic weight losses associated with some widely publicized diets. Salt in the diet may cause excessive retention of body fluids. Less well understood is the ability of glucose to induce water retention, making it possible at times for an individual to appear to eat "almost nothing" yet seem to be unable to lose

weight. Fat losses do occur, however, even though the scales refuse to acknowledge the success.

How can fat loss be measured? The use of the scale as the only method of measuring fat loss is not uncommon. If the possible errors pointed out in the preceding paragraph are understood, the common scale remains a useful, if somewhat limited tool. The thickness of the subcutaneous fatty tissue can be measured with special skinfold calipers. The skinfold caliper is designed to measure quite precisely the thickness of a folded section of skin and the fatty tissue layer that lies directly beneath it. Much of the excess body fat is stored in the subcutaneous tissue and during a period of negative energy balance it is possible to measure changes in specific parts. The calipers have easy-to-read dials that permit readings to the nearest millimeter. These instruments are particularly interesting to young women who are perhaps as much concerned about *where* the fat is as they are about *how much* there is. The tape measure is also a useful tool. Care must be taken in the actual placement of the tape and in the application of constant pressure during measurement if accurate readings are to be obtained. Anthropometric tape measures are available that have a spring-loaded cartridge which ensures a steady pressure. These are relatively expensive devices but they do help eliminate possible errors in girth measurements. Any girth measurement should be taken with a grain of salt. The measurement after all includes the skin, muscles and bone as well as the fat. Other, more accurate, methods are available for estimating the amount of fat on the body, but they are not practical for the usual class or club program. It may be of interest to the reader to know that absolutely accurate measurement of body fat can be made only after death. All measurements on the living are really only estimates.

Are there some good sources of information available? Yes, there are several. For the student who wants some plain answers to some plain questions the booklet *Key to Lasting Slimness*, by Corinne Collins, would be a good starting place. For the interested adult, the government booklet *Obesity and Health* is available from the U. S. Department of Health, Education, and Welfare (a complimentary copy will usually be sent to health and physical educators if the book is to be used for educational purposes). Finally, for the person who seeks in-depth information, but in a readable format, the recent book, *Overweight*, by Dr. Jean Mayer, is highly recommended. Dr. Mayer's research in the area of obesity and his knowledge of this field make it possible for the reader to get the latest possible information on obesity and its many related aspects. These suggested references are of course not suggested as a complete list of good source materials, but they will provide a start.

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CHAPTER XI

THE MENSTRUAL CYCLE AND PHYSICAL ACTIVITY

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That traditional attitudes toward and reactions to the menstrual process are difficult to alter may be at least partially related to the general lack of scientific knowledge about this often confusing subject. It is hoped that by presenting some basic physiological knowledge about the menstrual cycle to coaches and teachers of physical education the fears and misconceptions of many high school and college girls regarding physical activity during menstrual flow may be alleviated. The first part of this article is devoted to factual information gleaned from medical and physiological textbooks and journals, while the second part deals more directly with physical activity and how it might affect the menstrual cycle and be affected by it.

PHYSIOLOGY OF THE MENSTRUAL CYCLE

Basically, sex differentiation is determined by the anterior portion of that part of the brain called the pituitary. In the female, the *follicle stimulating hormone* (FSH) is secreted and acts directly on ovarian tissue to promote the development of primary structures (each containing an ovum) called follicles. The developing follicle produces an ovarian hormone of great importance and wide-ranging effects, *estrogen,* which is carried by the blood stream back to the controlling cerebral structures. By some mechanism not yet clearly understood, elevated estrogen levels in the blood inhibit further release of FSH, but stimulate the production and release of a second pituitary hormone, *luteinizing hormone* (LH). It is this hormone which triggers ovulation, the process converting the ovarian follicle to a body called the *corpus luteum.* The second major type of ovarian hormone, *progesterone,* is produced mainly from this newly formed corpus luteum. Progesterone in the blood stream signals the pituitary that the cycle is completed, thereby inhibiting further LH release. Thus one menstrual cycle is completed in terms of the brain's control over the ovary and the major hormone groups.

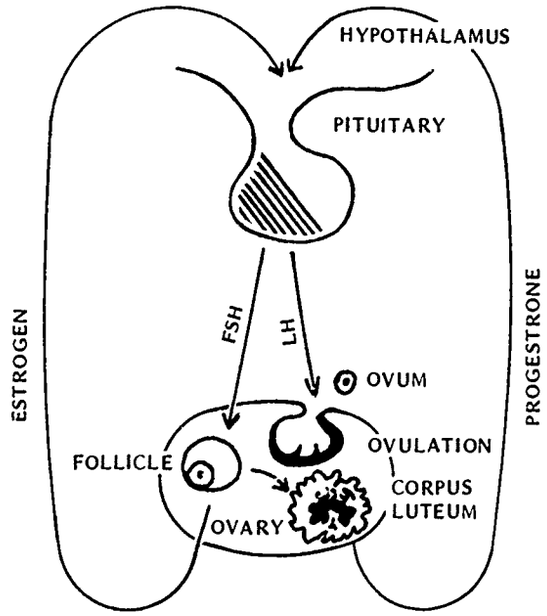

FIGURE 1 Hormonal Regulation (adapted from Levine (16))

The menstrual cycle may be divided into three distinct phases. The first, the period of menstrual bleeding, is usually from one to five or six days in duration. The second phase is often termed the proliferative or growth phase, and is characterized by the development of a mature follicle under the primary influence of estrogen, and by a thickening of the endometrial lining of the uterus. Some textbooks call this the estrogenic phase. The third phase of the cycle is controlled primarily by the hormone progesterone. This begins following ovulation (approximately 14 days from the first day of menstrual flow) and continues until flow again commences. This phase is characterized by the development of secretory glands in the endometrium and the predominance of the corpus luteum. The growth and development of the endometrial layer makes it possible for the uterus to support a fetus. Menstrual flow, scientifically termed *endometrial regression*, is the reversal of this growth and development process.

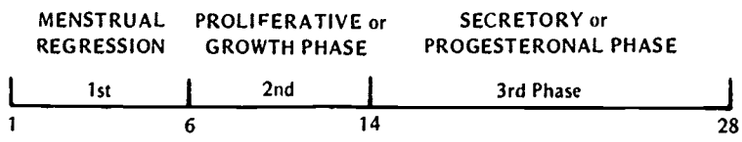

FIGURE 2 Phases of the Menstrual Cycle

Let us consider in more detail now each phase of the menstrual cycle as it relates to the endometrial lining of the uterus. The growth (or proliferative) phase is characterized by an increase in the volume of blood delivered to and circulating within the endometrial functionalis. This is paralleled by an increase in vascular and tissue growth, and of the total volume and proportion of extravascular fluids and solids. The arterioles of the endometrium undergo such an extraordinary lengthening in proportion to endometrial tissue growth that a complex system of kinks and coils are formed (leading to the term, "spiral arterioles"). These arteries are the sole supply of blood to the superficial third of the endometrium.

During the secretory phase, the increase in thickness and volume of the endometrium continues, but this phase is more marked by the progesterone stimulation of glandular structures and secretions within the now complete nidatory area. The uterus is now ready for implantation and able to provide adequate nutrition for a zygote should fertilization occur. The secretory phase is also marked by a transient accumulation of fluid in the endometrium and, at times, a diffuse premenstrual edema (accumulation of body water in various tissues) in peripheral tissues, which may become bloated. Body temperature is usually slightly higher during this post-ovulatory phase.

Endometrial regression, usually referred to as the first phase of the menstrual cycle because of the simplicity of noting day 1 of commencement of menstrual bleeding, actually marks the completion of the menstrual cycle. It occurs as the result of a process of circulatory deprivation primarily occurring because of a decrease in ovarian hormone production. If a placenta forms, then placental hormones maintain the corpus luteum as a functioning body and ovarian hormone influence is continued. With no placenta formation, corpus luteal regression leads to a sharp decrease in ovarian hormone secretion and the resulting menstrual flow. The circulatory deprivation is caused by arteriole constriction which in turn results in a shrinkage and collapse of the endometrial structures accumulated during phases two and three. The dense vascular structures rupture after being weakened by the ischemia that occurs with circulatory deprivation. Menstrual hemorrhage and the sloughing off of crumbling tissue due to dehydration results in a reorganization of the vascular bed and stabilization of circulatory activity at the basal level. The bleeding is primarily arterial in nature, but there is more tissue loss proportionately, than there is blood loss. The actual hemorrhaging occurs for a relatively short period of time, clotting occurring anywhere from 1 to 24 hours after the initial rupture of the vascular wall. Secondary hemorrhages may occur, but clotting usually follows immediately.

Breast tissues also change with peaks of ovarian hormone secretion. There may be slight tenderness (probably due to the retention of body fluids in glandular tissue) at ovulation and particularly several days prior to menstruation. Relief is experienced with the onset of menstrual flow. Premenstrual tension (hyper-irritability) and backache are commonly

associated with pre-menstrual edema. Occasionally this edema is apparent from the change in fit of shoes and rings. Headache is also a frequent symptom of premenstrual tension.

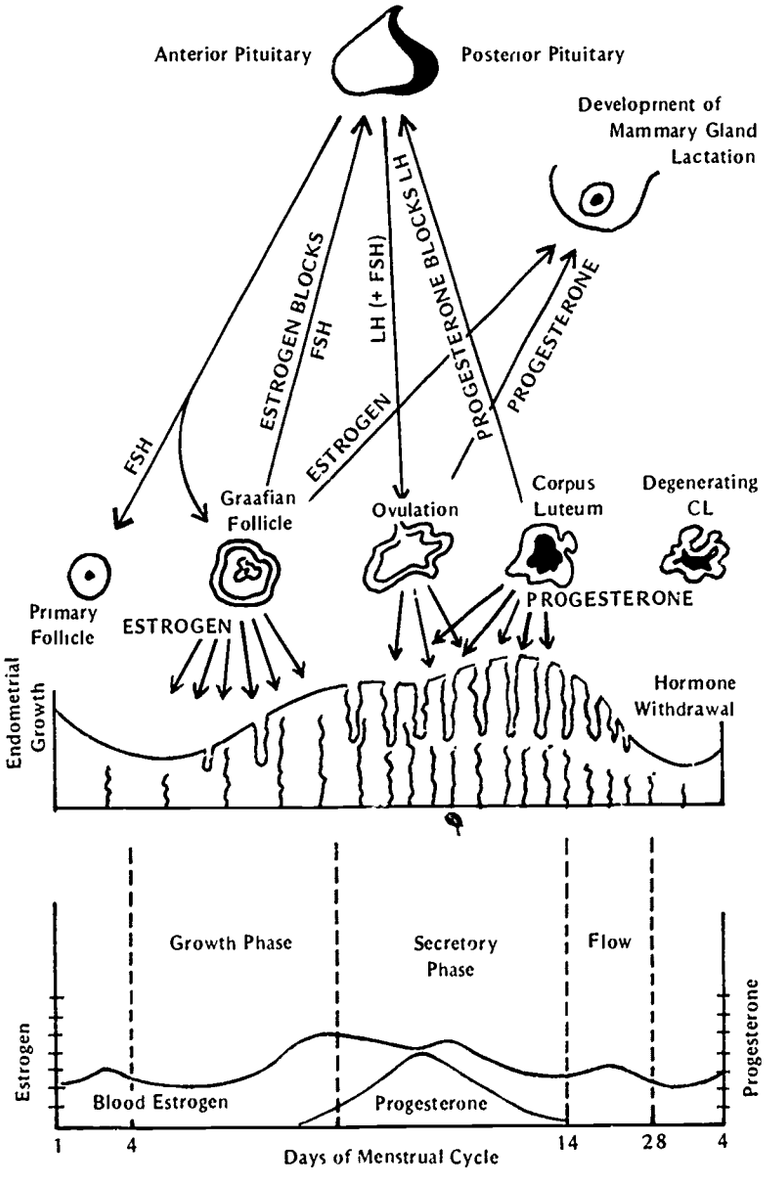

FIGURE 3 The Human Menstrual Cycle (adapted from Bard, (4))

A great many studies some of them dating back to 1923—investigated the effects of the menstrual cycle on athletic performance, the effects of exercise upon menstrual function, and the long term effects of exercise upon pregnancy and childbearing experiences. It is in this order that some of the particularly significant results found in the literature will be reviewed here.

HOW THE MENSTRUAL CYCLE AFFECTS ATHLETIC PERFORMANCE

Generally, slower heart rates and higher blood pressures have been observed during menstrual flow than during other phases of the menstrual cycle, with the highest values for these parameters obtained during the intermenstrual or ovulatory time (18, 21, 24, 25). One study (17) reported decreased muscular strength during menstrual flow, with intermenstrual strength always much higher. The method of testing strength, however, was rather dubious in terms of today's knowledge.

Tuttle and Frey (25) found that girls were more efficient during the preflow and flow phases of the cycle than at other phases in terms of heart rate and step-test performance. Scott and Tuttle (24), however, reported that highest efficiency occurred during the resting phases of the cycle, with poorest efficiency ratings occurring during flow. Many individual differences were seen, and the overall conclusion was that mean differences were probably due to factors other than menstruation.

Auster (3) found that static balance, grip strength, leglift and back lift scores were slightly but not significantly higher during the intermenstrual period. She noted, however that scores were less variable during the period of flow. Keenan (14) found that steadiness, weight shifting and grip strength scores were significantly better during the resting phase of the menstrual period than on the first day of flow.

A British study (5) indicated that menstrual flow had a detrimental effect on school grades. Of particular significance in this study were the results indicating that "times of stress" increased premenstrual symptoms, thereby imposing a greater handicap on school performance. Johnson (10) demonstrated a drop in learning curves at the onset of and during the menstrual period of subjects learning to walk a tight-wire. These results could indicate a drop in ability to concentrate or a loss of interest in what one is doing during the period of menstrual flow.

A more recent study (2) indicated that there are no significantly different results in performance during any one phase of the menstrual cycle as compared to any other phase. Rockwell (23) found poorer performances in the Sargent jump (explosive power) and the 100-yard shuttle run in college girls during the first 24 hours of menstrual flow than during other phases tested. She concluded that although these differences were slight they could perhaps make the difference between winning or losing a competitive event.

The studies reviewed above utilized volunteer subjects from various groups of high school and college students who demonstrated no particular athletic ability or menstrual disorder. Studies of perhaps even greater interest are those which concerned special athletic groups such as competitive teams, Olympic athletes, and national swimmers.

Surveys of athletic performance during Olympic competition have been fairly common. In the 1930 (Prague) track and field championships for women, 29 percent of the competitors produced their best performance during their menstrual period, 63 percent exhibited no change in their performance due to menstrual flow, and 8 percent noted a slight drop in efficiency of performance during menstruation (15).

The performances of Finnish sportswomen were surveyed at the Olympic games in Helsinki (9). Five attained their record scores during their period of menstrual flow, 20 reported that their performance during menstruation was better than their usual performance, 45 reported that their performance was not influenced by menstruation, and 39 reported that they performed less well during their menstrual period.

At Tokyo, Zaharieva (28) found that as many as 32 percent of the female competitors believed themselves weaker during their menstrual flow and that 26 percent were hesitant about their probable success because of menstrual flow. Best performances were found during the post- and inter-menstrual phases, with poorest performances just preceding the flow.

In a classic study of Swedish girl swimmers (2), it was reported that all the girls competed in an event if it coincided with their menstruation, but that many of them discontinued their training during this period. Nearly one-half of the girls swam least well during menstruation.

HOW STRENUOUS PHYSICAL ACTIVITY AFFECTS MENSTRUAL FUNCTION

Approximately one-third of the Swedish girl swimmers in the study cited above stated that strenuous swimming during menstruation caused pain in the lower part of the abdomen. Perhaps of greatest interest in this study, however, was that pathogenic organisms were recovered from the vaginas of nearly one-third of the swimmers. In regard to this last finding, the authors state:

> Under unfavorable conditions, there is a risk of infection in the reproductive organs due to these bacteria . . . this applies particularly during menstruation, when conditions for bacterial growth are improved, owing to pH change, and to the fact that the cervical canal is open to the uterine cavity, in which the sloughing mucosa is a good soil for bacteria. (p. 36)

They further state that chilling water and intense physical exertion may

lower the body's resistance to infection. They summarize their results regarding the menstrual cycle by saying

> "It seems warranted on medical grounds to advise against swimming—both training and competition—during menstruation."

On the other hand, experimental evidence has not indicated that exercise influences cyclic changes in uterine mucosa (1, 8, 11). Occasional menstrual irregularity (13) and an increase in flow have been reported (6) as a result of severe physical exertion. It is possible that these observations are the result of the emotional strain of competition rather than the physical activity itself and that these reports come from rather young girls at an age in which menstrual irregularity is the rule rather than the exception.

Several reports of decreased menstrual discomfort as a direct effect of exercise were found in the literature. It is well known that mild physical exercise may be a prophylactic for dysmenorrhea and that menstrual disorders are quite uncommon among active girls.

Basically, then, there appears to be no evidence suggesting that activities should be adjusted or adapted during the menstrual period for any normally functioning female. Accustomed activity should be continued, but perhaps excessive demands, such as compulsory swimming or strenuous competition, should not be made at this time.

HOW LONG TERM EXERCISE AFFECTS PREGNANCY AND CHILDBEARING

There is no experimental or clinical evidence to suggest that women who have participated frequently in vigorous athletic activities involving training and competition during all phases of the menstrual cycle have experienced any gynecological or obstetrical abnormalities because of that participation. Tokl (11) reported that skeletal measurements of former champion athletes show no departure from normal dimensions, and that obstetrical data obtained from female athletes are normal. Zaharieva (28) reported that female Olympians are more likely to have normal pregnancies than the average woman. Among Hungarian women athletes, Erenyi (7) found a smaller incidence of complications during pregnancy and 50 percent fewer Caesarian sections. Duration of labor was reported shorter than average in 87.2 percent of these athletes. No former swimming competitors included in the reports of Anderson (1) or Astrand, et al., (2) had experienced obstetrical, gynecological, or fertility problems.

RECOMMENDATIONS

Since there is no positive evidence to suggest that vigorous activity is a causative factor in dysmenorrhea or any menstrual discomfort, and since there appears to be no detrimental effect on pregnancy and childbearing,

there seems to be little basis for the attitude that exercise is harmful during menstrual flow. This is not to suggest that all girls should be forced to participate vigorously during menstruation, but simply that former customs, superstitions, antiquated mores, or fears of biological harm should not bar participation.

Frequently, a poor attitude toward menstruation is passed on from mother to daughter. Quite possibly girls ask (or their mothers ask for them) to be excused from physical activity during their menstrual period because of these attitudes. A good approach is to ask the girl if she is feeling really ill. If she is not, then instruct her to dress for activity and participate as much as she feels she is able to. Chances are she will play as vigorously as anyone else before the end of the class period. Be sure to allow plenty of opportunity during a gym period or practice session for a girl to leave the activity to attend to personal hygiene.

In regard to swimming, it appears that girls should be allowed freedom of choice as to participation. Anderson's treatment of this topic is highly commendable. She points out that girls learn about internal menstrual protection very early through mass media, other girls, or their mothers. Tampons are harmless and comfortable, and in today's rush to be "modern" most girls probably use them. Although menstrual fluid is biologically "cleaner" than normal nose, mouth, skin, and anal bacteria, swimming either with a sanitary napkin or with no protection during menstrual flow is not desirable. Perhaps parental permission should be required before internal protection devices are supplied in the locker room, where, no doubt, external napkins are already provided. This, of course, is more for the protection of the teacher or coach, and of other school authorities, than for the protection of the student.

Some premenstrual and menstrual symptoms such as the increased frequency of urination, increased peristalsis causing temporary bowel irregularity, abdominal bloating, tenderness of breast tissue, tendency toward backaches and headaches, and the temporary weight gain representative of water retention, may or may not interfere with top performance of the female athlete. Since individuals differ with respect to these symptoms, however, each performer should be guided on an individual basis when competition is involved, both for the benefit of the performer and of her perfo mance. Hopefully, wise counseling together with the "cool" intelligence encouraged during athletic training will enable the performer and her coach to make a wise decision.

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CHAPTER XII

PAIN AND ATHLETICS

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Pain, which comes from the Latin word *poena* meaning "penalty" or "punishment," warns the organism of damage. Several physiological alterations occur when pain is felt. A decrease in skin resistance accompanied by an increase in heart rate (1), and a sharp rise in blood pressure (26) have been noted. A respiratory rate increase of five breaths per minute has also been observed (8). These changes are compatible with those of the alarm reaction of the sympathetic nervous system—the so-called "fight or flight reaction".

Individuals vary widely in their willingness, or ability to tolerate pain. Coaches and physical educators are aware that pain always accompanies strenuous physical activity; therefore, an ability to withstand pain might aid an athlete in maintaining skilled performance. Pain tolerance, defined as the highest intensity of pain that an individual will voluntarily withstand, may be affected by several factors. Perceived pain is not proportional to the amount of tissue damage, because of the psychological component involved.

FACTORS RELATED TO PAIN TOLERANCE

Several factors are associated with pain tolerance. Lynn and Eysenck (16) found a significant correlation between extraversion and pain tolerance. Age was also found to be related to pain tolerance, with a higher tolerance demonstrated in individuals over fifty (22). Social class, or early childhood experiences, also seem to affect pain tolerance. Collins (7) found that subjects who were protected by parents in early childhood withstood greater pain. He felt that pain seemed less threatening to those who had limited experiences with it. Another study (22) found that college men had a higher pain tolerance than did unemployed workers of the same age. The authors hypothesized that the college men belonged to a higher social class and thus had been more protected in early childhood. Chapman (4) found that northern Europeans had a higher tolerance to pain than did Negroes of the same age group.

The existence of any sex difference in pain tolerance is uncertain. Hall and Stride (9) compared sex and intelligence to subjects' pain threshold. (Threshold reflects the minimum stimulus which can produce pain.) They

found no relationship between intelligence and pain responses, but did report that females had a lower threshold than males. Kennard (14) reported lower tolerance to pain by females; yet others (6, 10, 12, 17, 24) found no sex differences. Any differences between male and female pain responses could possible be attributed to socio-cultural mores.

Petrie's work (19) is of interest to physical educators. She classified individuals in terms of their perception of sensory experiences. The "reducer" tended to decrease whatever was perceived, while the "augmentor" increased it. In other words, the augmentor would report overestimation of the sensations of noise, smell, taste, time, size, or pain. Characteristics of the reducer were: greater desire for physical activity greater tolerance of pain, more frequent smoking, greater nail biting, slightly lower grades, greater number of accidents, more suffering from confinement and isolation, less need of sleep, and greater number of friends compared to the augmentor. In short, the reducer had a need for sensation of almost any type.

Pain tolerance may be increased if the individual is distracted from concentrating on the pain (18). The athletic contest might serve as a distractor for an athlete. "When one is engrossed in exciting or challenging tasks, physical injury may be sustained and yet go completely unnoticed until the activities cease." (3) Motivation may act as distraction in raising pain tolerance. One study (28) found that stressing the importance of the experiment to one group resulted in the group reporting less pain from the same stimulus than an unmotivated group.

THE MEASUREMENT OF PAIN

No completely satisfactory test of pain has been found. Such a test should provide a controllable and measurable stimulus, permit easy recognition of the stimulus as pain, permit reliable values to be obtained, cause a minimum of tissue damage, and allow rapid cessation of pain upon stimulus removal. The last two conditions are difficult to satisfy. As pain serves the protective function of warning the individual of damage and injury, some amount of tissue damage is necessary to stimulate the pain receptors. The most satisfactory pain stimulus should cause the greatest amount of pain with the least damage, so that the subject will reach his tolerance with little injury or lasting effect.

Heat was one of the earliest stimuli used to induce pain (11). Unfortunately, pain from a radiant heat stimulus may completely adapt, leaving only a feeling of warmth even when the heat is strong enough to cause burning of tissue (23). Cold has also been frequently used as a stimulus. Finger or hand immersion in ice water was the stimulus in several studies (1, 13, 15). Time limits are usually established to avoid frostbite and tissue damage. As a result of these safety procedures, a number of subjects failed to reach a tolerance within the time limits of the test.

Wolf and Jarvit (27) experimented with intramuscular injections of saline solutions of varying strengths. Only threshold values were obtained because of the danger of large injections. Chemical tests present the possibility of infection from the injection and also tend to cause lingering pain for some minutes. Several mechanical tests of pain have also been utilized. Pressure, applied by various methods, is usually the stimulus. Instruments, such as a metal band containing rubber tipped screws (8) and a football cleat pressed against the tibia (21), have been used to induce pain mechanically.

Many investigators have used electrical current as a pain stimulus. An electrical stimulus is more accurately controlled, more sharply localized, and of shorter duration than other types of stimuli (2). Clark and Bindra (5) report that electrical stimuli provide a more reliable measure of pain tolerance than radiant heat or mechanical pressure.

ATHLETIC PAIN RESPONSES

Many coaches believe that athletes are able to withstand high levels of pain. However, no supporting evidence existed until recent years. Ryan and Kovacic (21) felt that college athletes would not only demonstrate a high pain tolerance, but that the level of tolerance would determine individuals' category of participation. These beliefs were validated. A nonathletic group, a noncontact sports group, and a contact sports group were tested. Both athletic groups withstood greater painful stimuli than did the nonathletic group, while the contact sports athletes withstood higher levels of pain than did the noncontact sports athletes.

Ryan and Foster (20) repeated this experiment using high school boys. They found similar results using the younger boys, and also reported that athletes underestimated both time and size as Petrie (19) had suggested. No evidence exists which would indicate whether athletes choose a type of sport (contact or noncontact) because they have a high pain tolerance, or whether they develop a high tolerance while practicing their chosen sports. If the former is true, a pain-tolerance might be a valuable technique for selecting team membership. The identification of athletes as sensory reducers led the authors to speculate that students of widely different perceptual types might need varying amounts of physical education activity. The augmentor, who overestimates sensation, may well need less activity than does the reducer.

Both of the above studies involved male subjects. Walker (25) compared female athletes and nonathletes as to pain threshold and tolerance. The effect of pain on the performance of a skill task, and the effect of performing a skill task upon the subject's ability to withstand pain were also investigated. Increasing electric shock to the ulnar nerve at the elbow was used as the pain stimulus. A hand steadiness test constituted a skill task requiring both mental concentration and motor skill.

The athletic group was composed of members of the two college basketball teams. Team A was considered to be superior, although both teams were above average and had won more than fifty percent of their games. No difference was found in pain threshold between the athletes and nonathletes; yet the athletes demonstrated a decidedly higher pain tolerance than nonathletes. The athletes withstood 18.25 milliamperes of electricity in their preferred arm, as opposed to 10.57 milliamperes by the nonathletes. The athletes from team A also withstood more pain than did those from team B.

Both athletes and nonathletes were found to be more steady with the preferred hand than with the nonpreferred hand, while athletes were more steady with the nonpreferred hand than were the nonathletes. This was attributed to the athletes' practice of basketball skills with the nonpreferred hand.

It was felt that athletes' higher pain tolerance might be explained, in part, by the challenge of the activity acting as a distraction of the pain. In an attempt to validate this premise, subjects were further tested with concurrent administration of the pain stimulus and the skill task to contralateral arms. Neither athletes nor nonathletes tolerated more pain while engaging in the performance of the skill task. However, hand steadiness did decrease for both groups while the pain stimulus was being applied. Possibly the skill performance, which could be classifeid as a fine motor task, was not vigorous enough to act as a distractor to pain. A more gross task, similar to those found in sports, might well have produced different results.

SUMMARY

Three studies have found that athletes tolerate higher levels of pain than nonathletes. Athletes are also seen to be reducers of sensory perception and underestimators of time and size. They were found to be no better than nonathletes at a fine motor skill task performed with the preferred hand, but better than nonathletes at performing the same task with the nonpreferred hand. The performance of both athletes and nonathletes was impaired by concurrent pain. Athletes in contact sports possess a higher tolerance than do athletes in noncontact sports, and female athletes from one basketball team withstood more pain than did members of a second team judged to be inferior.

Information is lacking as to whether athletes possess a high pain tolerance prior to their participation, or whether such tolerance develops during participation. It would also be of interest to determine pain tolerance among athletes by sport and position played. More information is also needed on the effect of pain on motor performance, and on the distraction that athletic performance might be to pain perception. However, it appears that knowledge of an individual's pain tolerance might be a valuable diagnostic technique for coaches and physical educators.

Some of the data from this article are from a dissertation completed in 1970 at The University of Texas at Austin under the direction of Waneen Wyrick.

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SECTION 3

TEACHING AND COACHING ASPECTS

CHAPTER XIII

TEACHING BY THE BOOK

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Hopefully, professional students are now being exposed to some of the research related to how people learn motor skills so that, as teachers, they may use methods found to be most effective for the skill level and age of their students. Anyone who has presented skills to a group is aware that most students *do* learn. However, have we had the honesty to ask whether they learn because of us or in spite of us?

Studies of learning are difficult to design and carry out because they must deal with skills with which none of the students is familiar; yet at the same time the skills should be similar to those which would be taught in a physical education class so that the students may be motivated by the meaningfulness of the skill (which is not likely with such fine motor skills as startracing or doing a pursuit rotor task). In short, it is difficult to select meaningful motor skills with which none of the students is familiar.

In addition, it is impossible to control all factors related to learning so that the only variable is method. There is, for example, no valid way to determine that the students are equal in their potential to learn the skills. Each skill has its own specific demands. Numerous studies have shown that skills are specific, and that how fast one learns one skill may in no way be related to how fast he learns another. Could you determine who will be your good gymnasts by evaluating how these students play football? Are the members of your tennis varsity your best swimmers? There is no such thing as "general coordination" or "general motor ability." There are *many* coordinations, *many* motor abilities, *many* agilities, *many* kinds of balance. Scores on a motor ability test show only a low positive relationship to the learning of specific skills, so there is no value in giving motor ability tests to equate groups. Skill tests are known to be unreliable when given to beginners (because beginners are variable in their performance, and how they perform on successive trials will be inconsistent). Furthermore, research shows there is little predictive value from evaluations early in the learning period if the intent is to determine which students will be best at the end.

One need only consider the varying learning curves within a class to understand this. Sometimes students catch on very quickly when we present a skill and we anticipate that they will be our best performers after a few more weeks. Some of them are and some of them are not. Other

students start so slowly that we hardly notice their ability until suddenly near the end of the unit they seem to excel. What skills could we measure to determine that our classes are equal in their ability to learn the specific skill we are planning to teach? Only by eliminating students who already know the skill to be learned, by using large numbers of people, and by chance can we hope that our groups are not too different in their abilities and their motivations to learn. We must also recognize that how people learn seems to vary; learning is an individual matter.

However, in spite of the difficulty of designing a motor learning study and the results which frequently show "no significant differences" between groups taught by different methods, successful coaches and teachers who have studied motor learning have given us several guidelines and hypotheses related to teaching.

Genetic factors (such as the specific origin and insertion of muscles, the afferent and efferent nerve supply, and mechanisms for facilitation and inhibition of muscular responses) prescribe and limit our ultimate capacities, but except in case of highly skilled performers, it is doubtful that these differences are as significant as environmental opportunities. Complex motor skills are dependent upon and built upon previously learned skills; one needs a vast repertoire of movement experiences and elemental skill experiences. The greater the variety of movement experiences that the young child has, the better she will be able to learn new skills later on. The more experiences she has in all kinds of ball-handling skills, the easier it will be for her to learn a new ball-handling skill in spite of its specific demands. Even when the transfer from one task to another is very small, the experience of a wide variety of tasks, though immeasurable, appears to be crucial. In a physiological way yet unknown, one must draw upon past skill experiences in the learning of new skills. Thus, students who have been deprived of a wide background of movement skills have greater difficulty in learning specific sports skills. To teach the skills of basketball to a person who has not had a good background in running at various speeds, running and changing directions, and catching, throwing, and dribbling a ball is like trying to teach third year French to a person who has never had first year French.

Although teachers do not agree on what should be classified as fundamental motor skills, they do agree that the person who learns new skills more easily has had extensive practice in such skills as striking jumping for height and distance; throwing different size balls for distance, accuracy, and speed; running and changing directions; practicing many types of balance; and the like. Providing facilities, opportunities for practice, a good model to imitate, and as much encouragement as possible are all extremely important. By the time students have reached high school age, it is extremely difficult if not impossible to compensate for the background experiences some have missed. These students should probably be called "motor illiterates" because it is their lack of motor experiences more than other factors which causes their ineptness in

learning complex sports skills. Research has shown that remedial programs help girls to improve on the specific skills they practice such as jumping for height or distance or throwing a ball for distance or accuracy, but these students remain far inferior to others in learning specific sports skills. Apparently, no method of teaching can overcome the deficiencies incurred from having missed thousands of hours of practice during childhood.

With the poorly skilled, the best we can do is motivate, encourage, and help them get the general idea of the skills. Demonstration is one of the most meaningful techniques. When students are "stuck," demonstrate correct and incorrect performance and emphasize the difference in the aspect with which they are having difficulty. If they are unable to get through a skill themselves, use manual manipulation to guide them through it so they can feel the right pattern. Verbally express the goal of the muscular movements of the skill in terms of mental images meaningful to the students. For example, the movement of the lacrosse cradle might be likened to "opening and closing a door." The beginner and the poorly skilled may not have the "skill vocabulary" to understand verbal directions unless there is an analogy to some movement with which they are familiar.

It may also be valuable to teach the poorly skilled by the "part-whole" method because the part may be the largest unit they are capable of performing reasonably well. If the poorly skilled are so discouraged and frustrated by their unsuccessful practice of the whole, they probably would prefer to learn by the part method in spite of its known disadvantages. They may be motivated enough by their early success so that they may not mind relearning the timing of the entire skill when they put the parts together. True, they may encounter additional difficulties in the spots where the parts are linked together. True, there may be a hesitancy rather than a fluid flow of movement from one part to another when they try to put them together. However, their satisfaction in attaining success in performing the parts may be more important than these disadvantages of the part method.

On the other hand, it seems unwise to impose these limitations on those who do not need to learn by the part method. If students are able to practice an entire skill and reasonably approximate the end product desired, it is preferable to do it that way. One should only go back to practice a part if she is definitely stuck on that one aspect and repeated practice of the whole does not eliminate the difficulty. At this point, the learner has an overall concept of the entire skill and can mentally see where the part she must practice fits into the total skill. Practice on the specific part is more meaningful and challenging in such cases.

Research has confirmed that skills performed at a slow rate of speed are performed with different movement patterns than skills done at a fast rate. If the speed with which the skill is done is a significant factor in performing the skill, the teacher should emphasize this from the beginning and develop speed as much as possible. If both speed and accuracy are important, it is unwise to stress accuracy first and later introduce the

element of speed; accuracy attained at low rates of speed is not readily transferable to high rates. Apparently, the movement patterns are different, and one must relearn the skill. A teacher should emphasize both factors from the start so that students work on both from the beginning and develop both as they proceed. In tennis, for example, it is easy to be accurate with a "push serve" accomplished by using a bent elbow to hit underneath the ball. If this is the ultimate skill level desired, it is satisfactory. However, when one tries to increase the force of a serve done with this motion, the ball will go out of the service court. The player must change her serving pattern completely to develop more force. It would be better to stress a high ball toss, a straight hitting arm and hitting down on the ball from the beginning as this is the motion ultimately needed to produce a forceful serve. One wouldn't encourage "killing the ball," but would try to stress the mechanics which enable her to increase her force and accuracy later without having to change the pattern of her swing. As soon as possible, one must practice skills at the rate of speed required in the game situation. One might let students practice a drill at a slower rate of speed in order to get the general idea of the skill. The pace of the drill should be increased as soon as is possible to derive maximum value from the practice.

This principle also works in another way. If speed is not necessary, one shouldn't pressure players to show it. When a student teacher introduced an overhead pass in volleyball, she urged her students to get high sets. Their first drill was to see how many sets they could do in 15 seconds. The time element affected their practice so they set as low as they could in order to get more hits. A better practice would have been to let them practice passing the ball over a high rope. The rope would have been a better device for accomplishing the proper technique than her circle drill for time.

The awareness of performance being different at slow and fast speeds should affect how we demonstrate for our classes. The main purpose of a demonstration is to give beginners a general idea or an overall concept of the skill; they will not notice the small details of the performance that the advanced players will observe. A teacher should demonstrate not just once but a few times. The first time or two, the beginners may observe little more than whether the lay up does or does not go in the hoop. Demonstrate at the normal rate of speed of the skill for a few times; then do it once or twice at a slower rate while they are attempting to focus on one or two key features to which you have directed their attention. Beginners are not astute enough in their perception of the skill to be hindered by the differences in performance of a skill done in slow motion. Seeing it done slowly gives them a longer look at the overall concept of the skill. However, if the intention of your demonstration is to have a skilled player analyze the finer details of the skill, perform the skill at its normal speed. Your advanced players perceive much more during a demonstration and will look for small details which may help them to polish their own

performance. Therefore, it is important that they see the best demonstration of which the teacher is capable. Filming the demonstration and showing it in slow-motion is very helpful. The performer can demonstrate at a normal rate of speed so the movement patterns are realistic; however, the slow-motion allows the observer to study finer details and see more than she would from the demonstration at normal speed.

It may be easier to work with and help advanced players than beginners because of the variety of methods which are so effective with the former. I have heard inexperienced teachers say, "I'll work with the beginners; the advanced scare me." In my opinion, one must be more resourceful, creative, and patient when teaching beginners and the poorly skilled. One must be motivating and encouraging when they are struggling and discouraged; must think of simple but appealing ways to express the same idea over again when they don't catch on; must recognize their limited skills and knowledge and help them within the confines of this restricted framework without confusing and frustrating them. "Paralysis by analysis" is more common with beginners because they do so many things wrong. Teachers interrupt, correct so many details, and give them so much to think about that they become tense, self-conscious, and conscious of their muscular movements. This retards their speed of learning. After the teacher gives beginners the general idea of the skill, she should provide opportunities for them to practice. If they understand the goal, they will consciously or unconsciously revise their movements with each succeeding attempt. Practice allows trial and *revision* of error. When the beginner meets an insuperable obstacle and cannot refine her technique after many practice attempts, the teacher should interrupt and help her. The teacher must determine the most critical error or underlying cause of other errors, make suggestions, and ignore other imperfections at this moment. Methods the teacher could use satisfactorily with the advanced are not so effective with the beginner. Words are not so meaningful; analysis is difficult and meaningless. The beginner cannot incorporate a theoretical understanding of mechanical principles into her performance. Hopefully, demonstration, simple coaching cues, and manual manipulation will do the trick.

For more skilled players, the role of a demonstration is not so important because other methods supplement or replace demonstration. The teacher can verbalize more because the players understand the meaning of the words through their experience with the skill. It is easier for the advanced player to analyze what she is doing wrong and to understand the teacher's or a partner's analysis of her errors. While she concentrates on that one aspect of her performance, the rest of her movements are automatic enough to be relegated to subcortical control. She can derive meaningful practice from "part practice" because she sees where the part she is practicing fits into the entire act. Realizing she must perfect her skills to improve, a highly skilled player will work hard to correct minor errors even though she may not "enjoy" the practice. She knows the importance of drills and is willing to practice intently for long

periods to develop precision performance. If a well skilled player is unaware of an error in her performance and questions what the coach says she is doing, it may be useful for her to view her performance on video tape or on a film taken with a high-speed camera. This is particularly meaningful to a person who is consistent in her performance and repeatedly makes the same error. If no camera is available, the teacher must attempt to raise this automatic grooved error up to the awareness level of the performer. To do this, Lawther (8) suggests that the player practice the error so that when she does the incorrect move during a performance, she will become aware of the fact that she is committing the error. This is called constant error rehearsal.

The advanced player must learn to generalize her skills, that is, to perform them under varying conditions. The golfer practices on a wet course, a dry course with a lot of roll, a lush fairway, a burned-out fairway, sidehill, downhill, and uphill lies, heavy rough, with a tailwind, headwind, and crosswind. These factors affect her choice of club, length of backswing, and judgment regarding height and roll. To become an expert, the golfer must recognize the important differences in various playing conditions and be able to make the appropriate adaptations. A beginner is not usually even aware of these important factors. A skilled squash player judges where to move from watching the flight of the ball from her opponent's racket until it hits the front wall, whereas the beginner needs so much time to judge the ball that by the time she does, the ball has gone by her. Extensive practice is necessary to develop this kind of perception.

As well as providing a wide variety of conditions under which to practice, the teacher or coach must subject her advanced players to stressful situations so they can get used to performing under pressure. Frequently in a pressure situation, players revert to old bad habits which they thought they had corrected or realize they have not yet mastered a new technique well enough to rely on it in a game situation. Experience in stress-producing situations is an important part of an advanced player's training.

A teacher may encourage her more skilled players to practice mentally between practice sessions and games, and immediately before competing. Research has shown that mental practice is a helpful supplement to physical practice. It allows a player to concentrate on the features of her past performance, analyze and think through a play the team has been practicing, review in her mind the polishing touches of a skill, and analyze game strategy. She may think through new responses for different types of situations she anticipates she will encounter, and this should enable her to react more quickly and certainly in the game. Mental practice is part of "getting oneself up for the game."

There is much we need to learn about motor learning to become more effective teachers and coaches. We know little about the perceptual aspect of motor learning except the importance of sensory input and proprioceptive feedback. Tennis books state, "Keep your eye on the ball." We

must determine how long a highly skilled person needs to watch the ball and at what point in flight it is crucial to do this. Such knowledge would enable us to observe our opponent longer and rely on more than peripheral vision to ascertain the most strategic return. What type of training would most effectively help a player perceive the essential cues? We must discover what is happening physiologically within a person at various stages of the motor learning process; until we know this, we must use our most educated guesses to do what seems most effective in different situations.

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CHAPTER XIV

RESEARCH RELATED TO WOMEN IN SPORT: LEARNING ASPECTS

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Two of the underlying assumptions of any teaching are transfer of learning and retention. If we did not assume transfer, we would have to teach everything in specifics. There could be no change in environment; there could be no change in the situation in which the student operates. If we did not assume retention, we would have to teach the same lesson over and over. There could be no progression.

Transfer seems to have two bases: (a) identical elements, and (b) concept formation. The more common elements there are in the old task and the new task, the more likelihood there is of transfer. The learning and understanding of general rules or principles which can be applied to various situations also enhances transfer. It seems logical, despite the absence of supporting research, that in both instances the learner needs to be aware that transfer can occur. That is, we must teach for transfer. We must call attention to the similarities and differences between activities and we must actually teach basic generalizations. In addition, if we want maximum transfer to occur, the warm-ups and drills used must be as much like the game as possible. It is not game-like to have basketball players practice shooting from the field without guards, nor is it game-like to have hockey players practice passing to stationery teammates. In view of what we know about transfer, we need to look carefully at some of the drills we use.

Another type of transfer is cross transfer—for example, when a skill learned with one arm is partially transferred to the other, which can then learn the skill faster. Part of this speeding up may be caused by learning how to learn. Perhaps we should teach skills using the nonpreferred hand first in activities such as basketball where bilaterality is important, for there is some indication that if the most difficult aspect is learned first, the learning of simpler skills is easier and faster. If further research substantiates this, we may have to revamp our typical progressions of from simple to complex. In fact, many people have already done so.

A rather discouraging point about transfer is that we have very little evidence that some of the attitudes we claim to instill in students, such as sportsmanship, courage, and initiative, transfer to daily life.

Still another form of transfer is mental practice—thinking about the movement without overt practice. Almost without exception, studies have shown that mental practice can be of benefit, although of course not as much benefit as physical practice. Nevertheless, students who are not able to participate can gain some skill through mental rehearsal. We also should probably give homework; that is, students should be given assignments in which they are directed to think about the skills to be learned. One of the problems here is that we do not yet know the most effective ways of directing mental practice.

Retention is the opposite of forgetting. We expect students to remember what they have learned but at the same time we recognize that they will forget part of it, too. This is the reason for review. There are two points about retention that should be emphasized. The first is that overlearning enhances retention. Practice beyond one or two successful performances helps to "set" the learning. But there is a point at which one begins to get diminishing returns, a point at which continued practice does not benefit the learner *unless* he is changing his methodology. If we err in any direction, it seems to me that we allow students to practice for too long a time. Practice for practice's sake is a waste of time.

The second point is that gross motor skills are extremely well retained for long periods of time and are relearned to previous levels very rapidly. This indicates that we spend much too much time reviewing. A student learns basic volleyball skills at the elementary level, then reviews them at junior high level, senior high level, and sometimes at the college level. No wonder they are not highly skilled in volleyball. In addition, I wonder whether in some activities the advanced skills do not contain some of the basic elements of the simple skills. If this is so, the student could be reviewing simpler skills at the same time she was learning a new skill.

Performance curves for women tend to level off or even drop after the age of about 14 while those of men continue to rise for some time after that. This difference appears to reflect cultural influences more than an actual change in ability to learn or to perform. In our society, physical ineptness is accepted and perhaps even expected of women after puberty. Coaches and teachers can perpetuate this illusion by not encouraging skilled performance from high school and college women.

Good performers seem to have better kinesthetic perception than poor performers. We know that the ability to feel a movement pattern is important, but we know very little about how to teach or coach so that kinesthetic memories are developed. Since many of the proprioceptors concerned with kinesthesis are located in the tendons and joints, it seems important that beginners go through the full range of motions necessary to successful performance of a motor skill.

Beginners seem to benefit from some sort of visual explanation, whether it be demonstration, loop films, or motion pictures. As far as demonstrations are concerned, they seem to be of benefit during early stages of learning because they enable the learner to form a concept of

what he is to do. Those who disagree with this idea maintain that if you want the final performance to function on the basis of kinesthetic feedback, you make it more difficult when you initiate instruction using visual feedback. I personally feel that demonstrations are of value and should be used—not necessarily for the learner to imitate, but as I said, to give him a concept of what he is to do. This requires that the demonstration be accurate. If it is not, the learner may incorporate the incorrect aspects into his own performance. There are many examples of this. Recently I was demonstrating juggling to a group of students and made the fatal mistake of showing them the incorrect movement of ssing the ball from one hand to the other. What happened? They all b in by handing the ball from one hand to the other the same way. Or witness the little league pitcher who pulls down his cap and hitches up his britches before beginning to pitch. While these movements are not necessarily incorrect aspects of the performance, they are extraneous movements and not necessary to successful performance.

Demonstrations should be seen at the speed at which the movement is to be performed. A demonstration in slow motion is simply not depicting the movement pattern which the learner is ultimately to perform. Parenthetically, in activities where both speed and accuracy are important, both should be emphasized from the beginning. Traditionally, we have emphasized accuracy first, then added speed when accuracy is achieved. Studies show that when this practice is followed, accuracy is lost.

Two speculations about demonstrations: Probably the learner needs to see several demonstrations with attention called to different aspects of the movement with each demonstration. And perhaps she needs to see the demonstrations from different angles. A volleyball serve looks quite different from a back, side, and front view.

Long detailed verbal explanations do not appear to be of much benefit to beginners. Part of this may be that the beginners do not understand the vocabulary of the activity. The more skilled the teacher, the less she talks because she has learned what to say. We need to find out what cues to give the learner so that his learning will proceed as rapidly as possible. We need to know whether championship performers communicate with themselves as they perform. If so, what do they say? When do they say it? Before, during, or after? Perhaps the learner needs to verbalize to himself (or out loud or to someone else) about what he is trying to do.

Also, we have observed that in activities such as the shotput where maximum effort is required, many performers give a loud, explosive verbal expression as they reach the point of maximum exertion. Is it possible that verbal expressions could be of benefit in other kinds of performance? Perhaps in a basketball free throw, a rather soft movement really, we should teach performers to say "ah!" as they release the ball.

On the whole, researchers are in agreement that short, frequent practice periods are of more benefit to beginners than long practice

periods. As the level of skill is increased, longer periods of practice may be helpful, particularly in activities where mental set is important. One reason short practice periods may be better for beginners is that these players use many extraneous movements and hence fatigue more quickly. On the other hand, there is some evidence that fatigue may not be detrimental to the actual learning. Even though performance level may drop as a result of fatigue, increased learning may be displayed at a later date. Could it be that we need to fatigue women more than we do if our ultimate aim is high skill level?

Research indicates that the "whole" method of learning is superior to the "part" method of learning, although this appears to depend on the task to be learned. For example, the results of one study indicate that students acquire more power and accuracy in the golf swing when they practice the entire swing from the beginning than when they learn a quarter swing first, a half swing, and then the full swing. Part of the reasoning behind the suggestion that the whole method be used is that one part of the skill may furnish kinesthetic cues for another part. The feeling of standing still and swinging a bowling ball provides quite different kinesthetic cues from a situation in which the body as well as the ball is moving on the approach.

With few exceptions, students display a definite preference for using one hand, one eye, one foot, or side in motor activities. Individuals do not seem to have a consistent pattern for this preference, especially where the lower limbs are concerned. That is, a person may prefer to kick with one foot and hop with the other. What justification is there, then, for demanding that all students kick with the right foot? Does it matter which foot is back in the track start? Should all swimmers be taught the side stroke facing the same end of the pool? What do we do to students when we say, "This is how the skill is done, but if you are left handed, reverse it"? Recently, quite a lot of work has been done on lateral dominance, but unfortunately little of it has been done by physical educators.

Another area of increasing concern is the role of movement in developing or changing body image and self-concept and, conversely, the role of body image and self-concept in developing movement potential. Can we as teachers and coaches of movement influence body image in a positive way? If so, how? If movement experiences change body image, do movement experiences help women to feel better about themselves? Though many of us would probably answer the first and third question in the affirmative, we need many more systematic investigations to be sure.

In conclusion, we do know quite a lot about the psychological aspects of motor learning. Our greatest need in this connection is to apply what we know. But a far more crying need is to find out more about motor learning and motor performance, especially of women.

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CHAPTER XV

TEACHING FOR RETENTION

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Much of the literature dealing with the teaching of motor skills is concerned with methods of practice, such as whole versus part presentation of skills, massed versus distributed practice, etc. The aim seems to be at methods which will produce the highest degree of skill at the end of the allotted practice period. An implied outcome is that the greater the learning the better the retention. Ultimately, retention of skills should be of vital interest to physical education. A frequently stated objective is that skills learned in physical education classes should carry over to the time when people are out of school. These skills can then be employed as leisure-time activities. In addition, retention throughout the school years is also necessary if programs are to include progression from year to year. Consequently, teachers are concerned with the best (i.e., most economical and efficient) way to promote the learning and retention of motor skills.

It seems only logical to look to research for answers to our questions on how to bring about maximum retention. Although evidence on a number of points is somewhat conflicting, there are several generalizations which seem warranted. Before we discuss specifics, a look at the way retention is measured seems worthwhile. Traditionally the three methods employed are: recall, recognition, and relearning. Generally, recall shows the least retention. This method would be analagous to the motor skill test approach, such as having the student perform a gymnastic stunt he learned previously, or timing the length of his performance of a speed skill. The latter could of course be affected by a change in physical condition over the retention interval. Skill tests involving several trials such as free-throw shooting in basketball may include some relearning during the performance of the test and, consequently, are not based on simply recall. The second method, recognition, is not frequently used to assess retention of motor skills. The final method, relearning, is frequently used. Relearning of a skill is easier and takes less time than original learning. Most lists of principles for lesson and unit planning include this method. The ideas that the lesson start with a review from previous lessons, that the lesson end with a familiar activity, that an intermediate or advance unit start off with a review of elementary skills all employ relearning even though the objective may not be the testing of retention.

Basically, two changes take place during forgetting. One is quantitative, the other qualitative. Quantitative changes refer to the amount

forgotten. Increased performance time, the numbe. of ... the distance thrown, etc., could all indicate a certain ...ty" lost. Qualitative changes, on the other hand, include actual change in the form of the performance. The loss of some of the finer aspects of a skill could be involved here, or even basic changes in the general coordination of the skill. Generally, this qualitative aspect is difficult to measure objectively, although some aspects are probably reflected in quantitative measures.

Fortunately, forgetting is rarely, if ever, complete. It tends to be rapid at first, then it levels off and shows only slight changes over long periods of time. The basic elements of the skill seem to be retained better than the finer points. In fact, one may never lose some of the basics. Consequently, although one may not have ridden a bicycle for 25 years, he can usually ride immediately upon trying. Granted the skill may appear a little shaky at first, but relearning is very rapid.

There are several factors which can affect this more generalized forgetting trend. Of primary importance is the degree of overlearning. Overlearning means that practice continues after initial success with the task has been achieved. Overlearning is a common practice with motor skills. For example, we do not try to do a head stand and quit at the first successful effort satisfied that we have mastered the stunt. Indeed, practice is continued for many successful trials. In learning the breast stroke we do not swim the complete stroke just once, but repeat it over and over again. The evidence on rete..tion of motor skills indicates there is a high resistance to forgetting and overlearning is the primary cause. Consequently, the implication is that practice should continue well beyond one point of initial mastery. How far beyond this point is not as clear. Usually overlearning is expressed as a percentage. If it took 30 minutes of practice to reach the learning criterion, the addition of 15 more minutes of practice would be 50 percent overlearning, 30 more minutes would be 100 percent overlearning. Generally, the greater the overlearning the better the retention. However, the greatest effect seems to be in the first 50 percent of overlearning. In addition, as the length of time over which the skill must be retained increases, the more important overlearning becomes as a method to prevent forgetting. Studies have shown essentially no forgetting of well learned motor tasks for periods of a year or more.

The problem of interference from the learning of similar tasks is also lessened if the original task is overlearned. The learning of badminton and tennis immediately comes to mind. Generally, if the first one is well learned, i.e., overlearned, it is less susceptible to interference, i.e. less disruptive and forgetting, when the second sport is taught. Consequently, it would be best to introduce badminton into the program only after students have had considerable practice in tennis (or vice versa). Dissimilar tasks usually do not have interference effects on each other.

Knowledge of results during the course of practice aids in retention. This simply means that people remember better if they have received feedback regarding their success during practice. Most motor skills have a

certain amount of built-in feedback: the student knows if he got the ball in the basket, if the jump was successful, etc. For skills with little built-in feedback, skill testing periodically throughout practice will help give the student a more objective evaluation of how he is doing in relation to his own goals or predetermined norms. Possibly knowledge of results functions partially as a motivating device, thereby aiding retention.

Complexity of the skill to be learned affects retention as well. For highly complex tasks overlearning becomes an important factor. Such tasks frequently require a greater degree of overlearning than simple tasks if they are going to be retained equally well.

Any discussion of forgetting should include some mention of the role of mental practice. This type of practice involves thinking through the performance without actually doing the task physically. Improvement in performance as a result of mental practice can usually be demonstrated. However, the amount is small compared to actual physical practice. Examination of the evidence indicates that a major advantage of mental practice is that the skill is more resistant to forgetting.

Forgetting can sometimes be a temporary phenomenon. Although we tend to think of temporary forgetting more in connection with verbal learning, it also occurs in motor learning. Loss of concentration can result in temporary forgetting of essential aspects of a skill. It sometimes happens, for example, that a gymnast or diver will have a "block" in the performance of a stunt even though it is one he generally does well. Emotional stress can also produce temporary forgetting. The general effect seems to be one of disruption of the proper coordination of the skill. Whether or not this can be considered forgetting is debatable. However, the end effect is one of temporary forgetting. Usually when the stresses are removed, proper performance of a skill is remembered.

Recent research on memory has identified three different processes which evidently have neuro-physiological bases. These are termed by some as immediate memory, short-term memory, and long-term memory. The first lasts for only a few seconds or minutes, the second for up to a few hours, and the last persists over many days, weeks, or months. Each is thought to involve separate neuro-physiological processes.

Little is known about the best way to transfer from one storage or memory system to another—from immediate to short term to long term. From a practical standpoint, factors such as the number of trials, the degree of motivation, the significance of the initial success all seem to produce this transfer. In addition, a certain amount of distribution of practice also seems beneficial. Whether such distribution allows for consolidation of these different kinds of memory or simply combats boredom and fatigue is somewhat debatable. In any case some degree of distribution of practice seems to be desirable for both learning and retention.

In summary, the following points on retention of motor skills are useful and seem justified by research:

1. The degree of skill is lost and the form of the skill can change over time when no practice takes place.
2. Periodic reviews aid in preventing forgetting and in retaining the original skill level.
3. Overlearning of a skill aids in retention.
4. The basic elements of a skill are retained longer than the finer elements.
5. The longer the retention interval, the greater the overlearning required.
6. The greater the overlearning of a skill, the less subject that skill is to negative transfer from the subsequent learning of similar skills.
7. Mental practice helps prevent forgetting.
8. Too much overlearning can result in boredom and fatigue. Varying the practice drills will aid in keeping additional practice interesting.
9. Meaningful material is better retained than that which lacks meaning or relevancy for the learner.
10. Give the learner a clear picture of the total skill to be learned before breaking it down into parts.
11. Complex skills are less well retained than simple skills. Complex skills require a greater amount of overlearning for good retention.
12. Some degree of distribution of practice within the class period is desirable to promote proper consolidation of memory traces and to prevent boredom and fatigue.
13. Skills are retained better if one expects to be tested on them later.

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